

ELECTRICAL REVIEW

FRIDAY
10 MARCH 1961

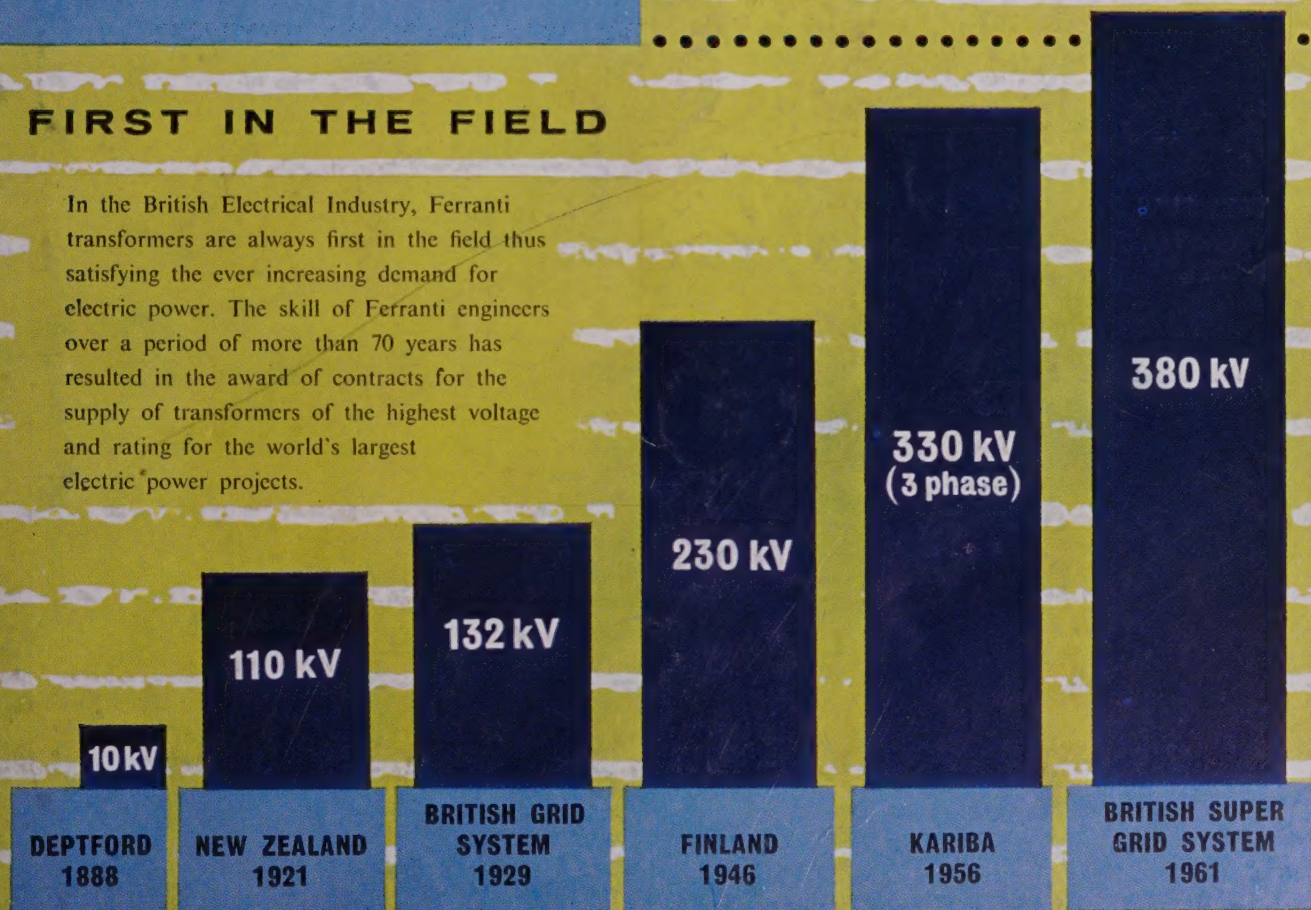
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In the British Electrical Industry, Ferranti transformers are always first in the field thus satisfying the ever increasing demand for electric power. The skill of Ferranti engineers over a period of more than 70 years has resulted in the award of contracts for the supply of transformers of the highest voltage and rating for the world's largest electric power projects.



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First into the Future

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THE SIREN
WHISTLING
KETTLE

with



ELECTRICAL APPLIANCES & GROUND BASE ALUMINIUM HOLLOWARE

The "Siren" Whistling Kettle is one of the fine Swan Brand range of Electric Kettles and Appliances. See Swan Brand on Stand No. H19 at the Electrical Engineers (A.S.E.E.) Exhibition, Earls Court, 1961.

Big Space **ADVERTISING**
in leading women's journals is
creating increased sales for
SWAN BRAND

ANNOUNCEMENT

British break-through in fluorescent lighting

Atlas are proud to announce a significant break-through by British technicians in the field of fluorescent lighting, bringing a considerable increase in efficiency plus total savings of as much as 25% on the capital and operating costs of larger installations.

Basis of the advance is the development by Atlas of a new 8 ft. 85 watt tube and new low loss control gear which makes the twin 8 ft. 85 watt fitting the best economic proposition for most industrial and commercial lighting purposes.

The 85 watt tube, which incorporates

entirely new manufacturing techniques, achieves the considerably high figure of over 80 lumens per watt initial efficiency ('White' colour) and, at the same time, combines long life with the high average efficiency of 74 lumens per watt. The brightness of the tube is much lower than either the 5 ft. 80 watt or 8 ft. 125 watt ratings so that even when no diffusers are employed there is less risk of glare.

The special twin low loss Atlas control gear, developed to operate two 8 ft. 85 watt tubes, consists of only one component, set for 230/240v. It provides a

quick and reliable switchless start with total wattage loss for the two tubes of only 35 watts and extremely high power factor of more than 0.95.

Together these advances form the new Atlas Super 8 circuit — designed to operate two 8 ft. 85 watt tubes.

When incorporated with the new Atlas Atlantic 2 fittings, which include many novel design features and a complete range of reflector and diffuser attachments, Atlas Super 8 offers the most advanced fluorescent lighting circuit available today.

atlas super 8 fluorescent lighting circuit

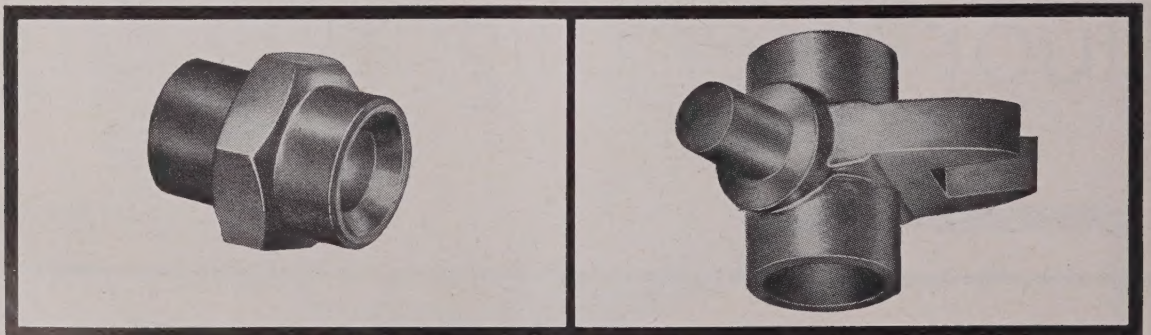
advantages of **atlas super 8** twin 8ft 85 watt tube circuit
and fittings over twin 5ft 80 watt tube fittings

- 25% higher 'lumens per watt' tube efficiency
- 35% more 'lumens per tube' for same loading
- 10% extra efficiency in enclosed diffuser fittings
- 17% lower surface brightness
- 15% saving in installation and fitting costs
- 35% saving in electricity costs
- 25% saving in annual lighting costs

Atlas Lighting Limited Thorn House Upper St. Martin's Lane London WC2



The choice is often difficult



choosing a winner calls for expert judgment...

...and it's the same when choosing between Die Castings and Hot Pressings. For expert advice come to us, for we make *both*! The special experience of our organisation — two separate yet inter-related operations under one roof — is your guarantee of obtaining the correct unit for *your* needs.

Whenever you require a constant or phased supply of dimensionally accurate parts in *Brass, Bronze, Copper* or *Aluminium* — see us first! Our technical representatives are always at your service.

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NON-FERDICA WORKS, NORTH CIRCULAR ROAD, LONDON, N.W.2. Telephone: GLAdstone 6377



Aluminium sheathed cables—a growing market

OVER 100 miles of aluminium tube is rolled on to drums like these at Rogerstone, Monmouthshire, every month; it goes to cable makers all over England. More material leaves in the form of strip, for those cable makers who make their own tube by seam welding. These tubes become sheathing for insulated cables.

Four main classes of cable are being made with aluminium sheaths.

Supertension Power Cables

These are filled with gas or oil under pressure. Aluminium sheaths can resist this pressure without reinforcement. Pressure-type cables with aluminium sheaths are notably smaller and lighter, and cheaper, than alternative constructions.

Paper Insulated Power Cables

Aluminium sheathed cables are being increasingly used for power distribution in factories of all kinds. The advantages of aluminium over other cladding materials include—light-

ness, strength, economy, good resistance to corrosion, and the ability to withstand vibration.

Rubber or Plastic Insulated Wiring Cables

In factories or office buildings, aluminium sheathed cables provide neat and cheap installations; many orders today are repeat orders from satisfied customers.

Telecommunication Cables

Here aluminium's advantage is its good conductivity. An aluminium sheath screens the communication circuits against interference from near-by power cables, and prevents dangerous build-up of induced voltages.

Ask your cable supplier to quote you for aluminium sheathing next time you enquire for cables. For further information write to: Alcan (U.K.) Limited, Aluminium Canada House, 30 Berkeley Square, London, W.1. Telephone MAYfair 9721.

Britain's most widely used aluminium

ALCAN  ALUMINIUM

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STAND H13 & H15

**MERSEY
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Electrical Division

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Telephone: **BOOTLE 4111**

Medium-size a.c. motors

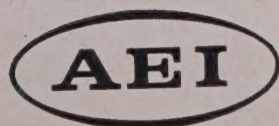
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is offered of all the following foot-mounted induction motors.
The ratings listed are for 400/440 volt, 3-phase, 50-cycle supplies.

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Screen-protected		Totally enclosed fan-cooled	
<i>h.p.</i>	<i>speed r.p.m.</i>	<i>h.p.</i>	<i>speed r.p.m.</i>
30	970	25	730
30	725	40	975
50	725	40	730
*55	720	50	1475
70	720	50	730
*75	970	65	1475
100	1455	†65	1475
100	725	†65	975
*125	1465	†80	1465
*130	970	†85	950
		100	1480
		†100	1450
SLIPRING (BS 2613)			
Screen-protected		*drip-proof enclosure † totally-enclosed closed air circuit motors, radiator cooled.	
<i>h.p.</i>	<i>speed r.p.m.</i>		
30	965		
50	1450		

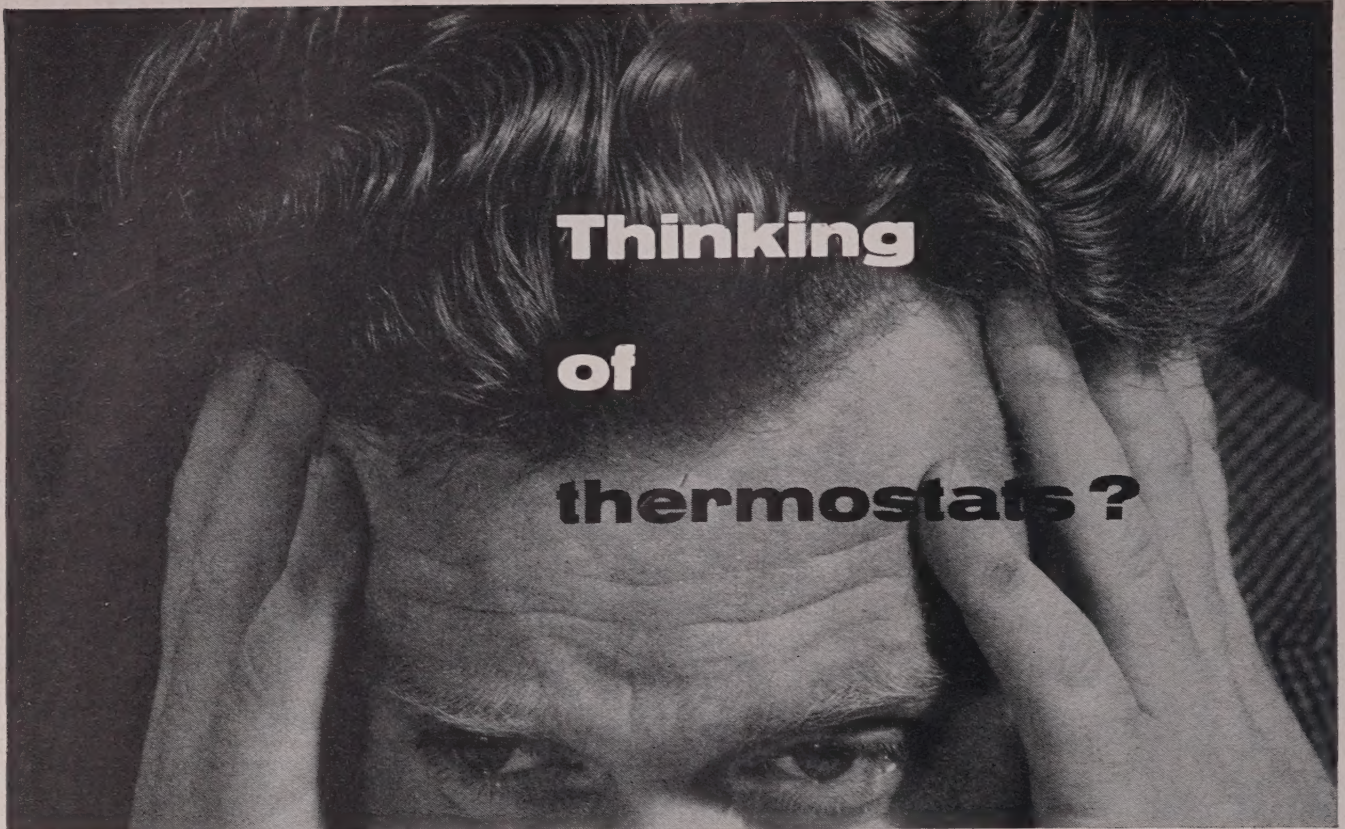
For further details of these and other AEI stock motor ranges, please contact your local AEI district office or Industrial Machines Dept., Mosley Road Works, Trafford Park, Manchester 17. Telephone No. Trafford Park 2431. Extension 1212.



Associated Electrical Industries Limited
Motor & Control Gear Division
 RUGBY AND MANCHESTER, ENGLAND

Visit Stand No. K.14 at the A.S.E.E. Exhibition, Earls Court, March 21-25

A5573



**Thinking
of
thermostats?**

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STAND T11

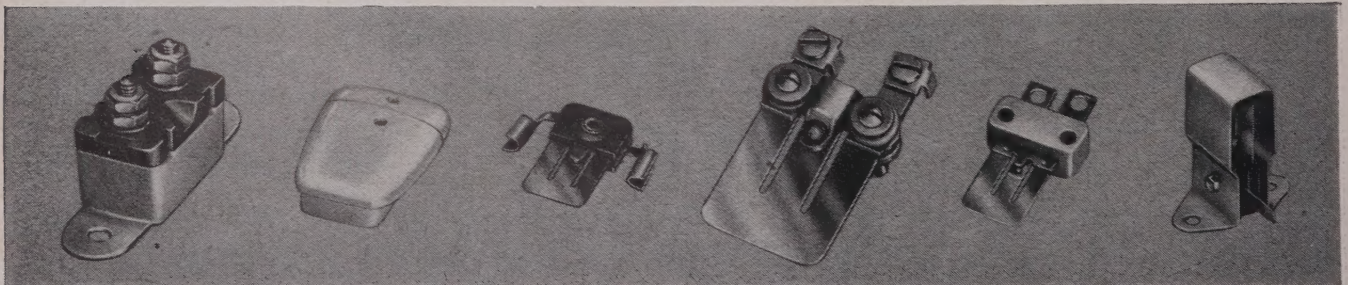
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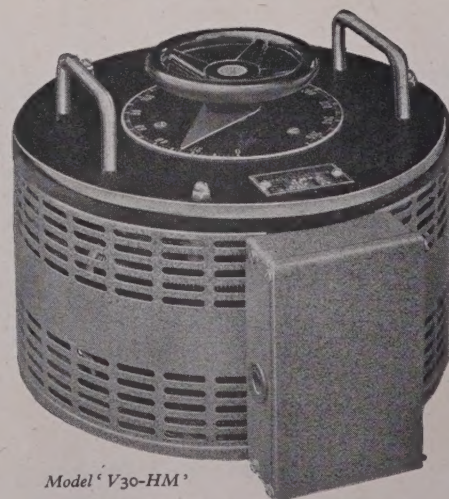
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This model, rated at 4.2 kVA, gives a voltage range of 0-270 volts at 15/17.5 amperes from a 240-volt supply.

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The Simplex Pole Top Screwglass is weatherproof and therefore suitable for all industrial and commercial applications.

It will take Tungsten or Mercury Fluorescent Lamps. The reflector is made from top quality anodised aluminium, stove enamelled red, yellow, turquoise, black or white as required. The moulded screwneck glass is internally etched to avoid glare and is protected by a strong galvanised wire guard.

The comprehensive range of Screwglass Fittings allow easy installation in any situation, top or side entry, or wall mounting. Interchangeable Nylon reflectors in either red, yellow, blue, white or black can be added to enhance appearance.

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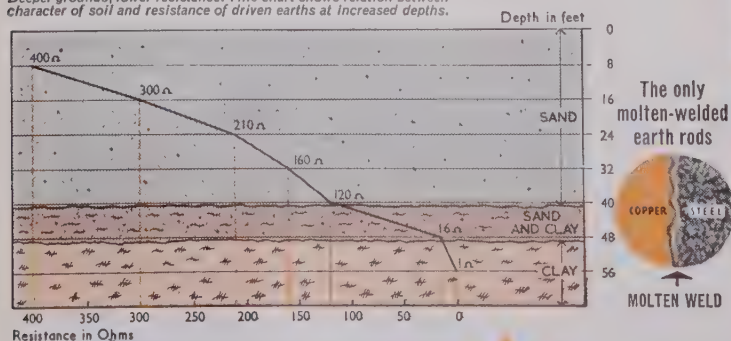
a new
pole top
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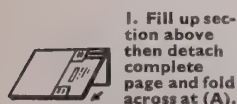
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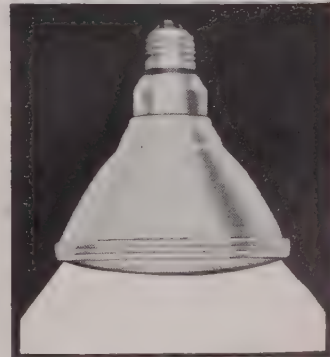
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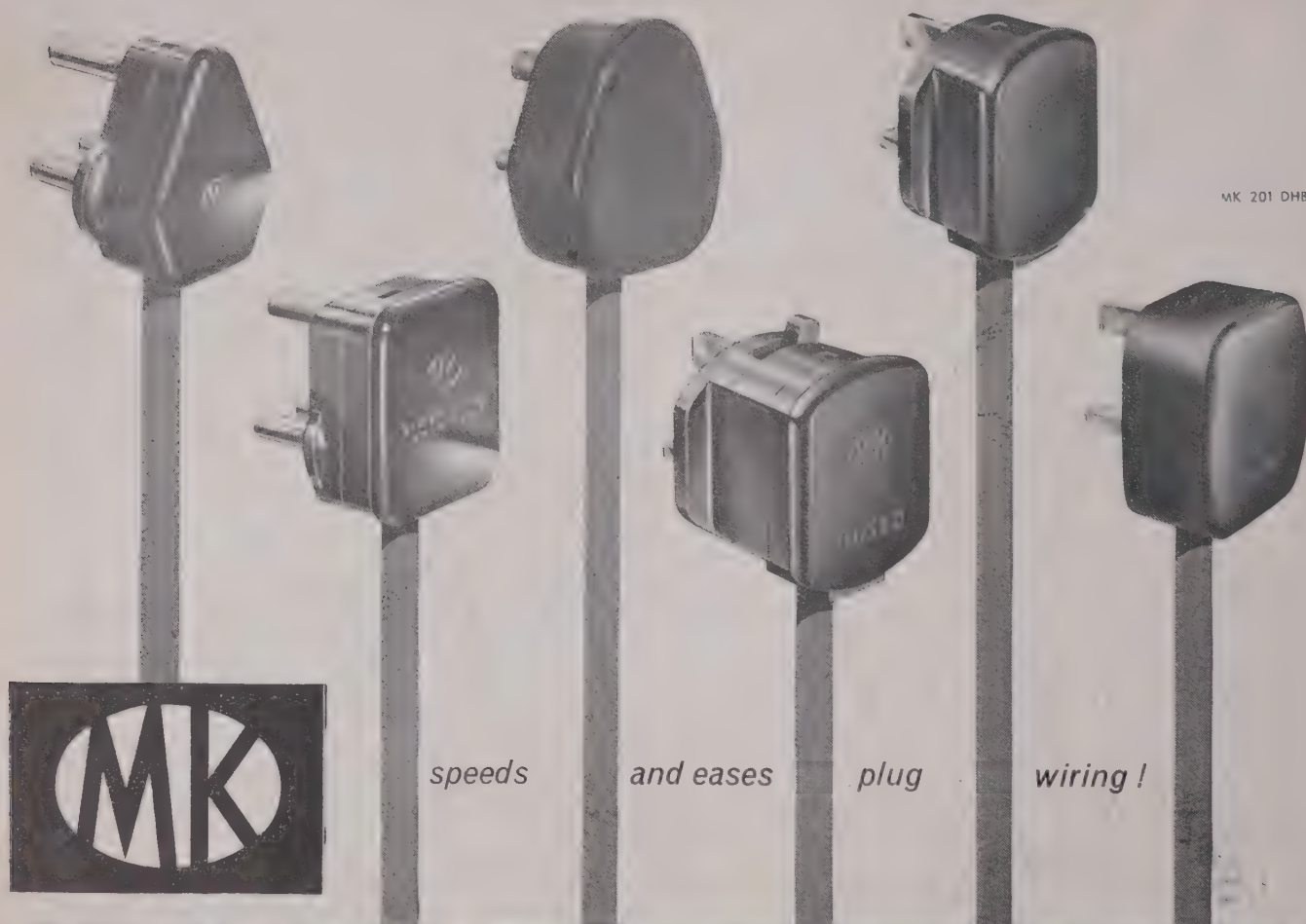
150 watt Spotlamp
(LD3292)



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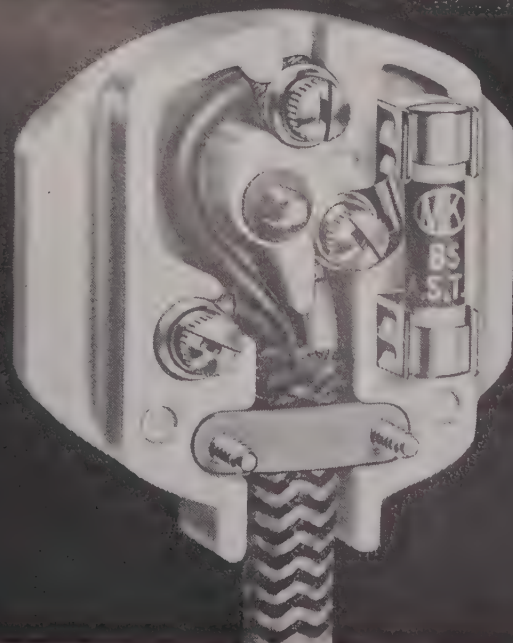
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THE feature which gives leadership in plug design !



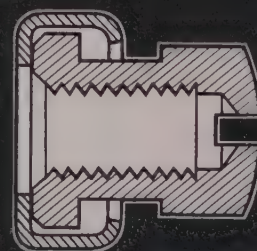
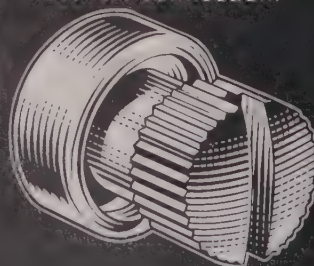
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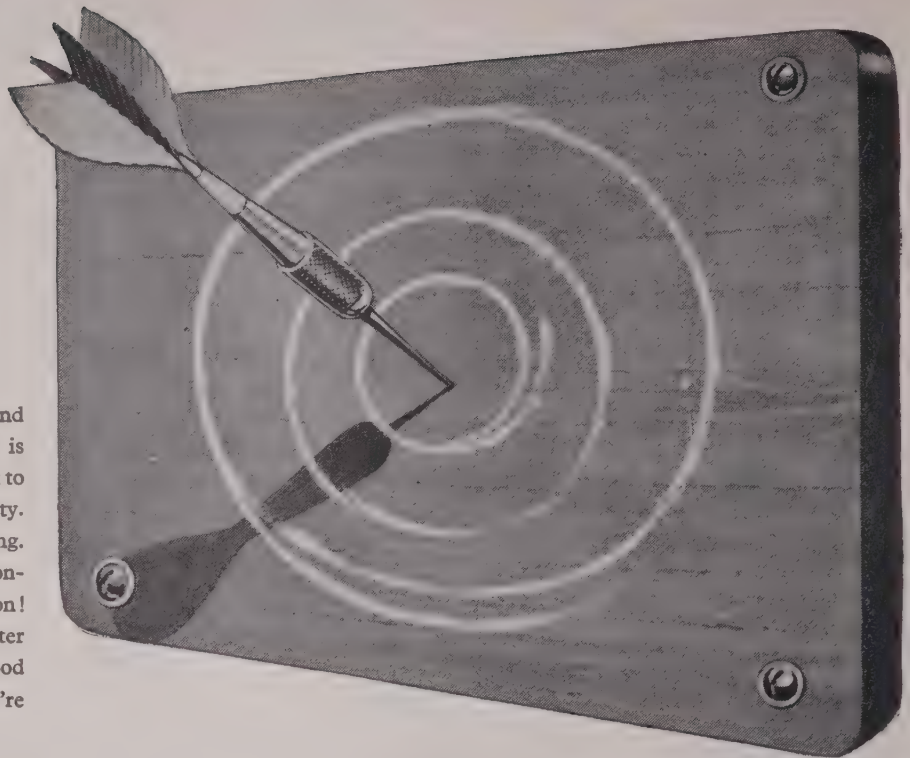


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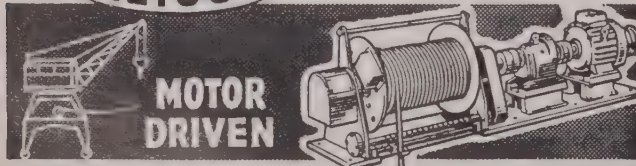
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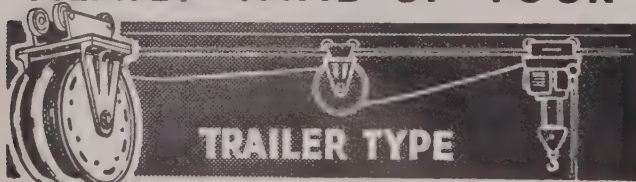
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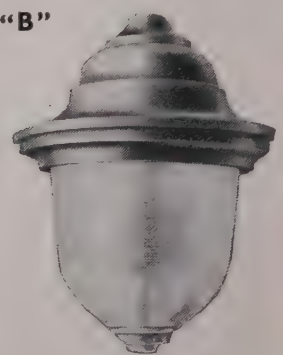


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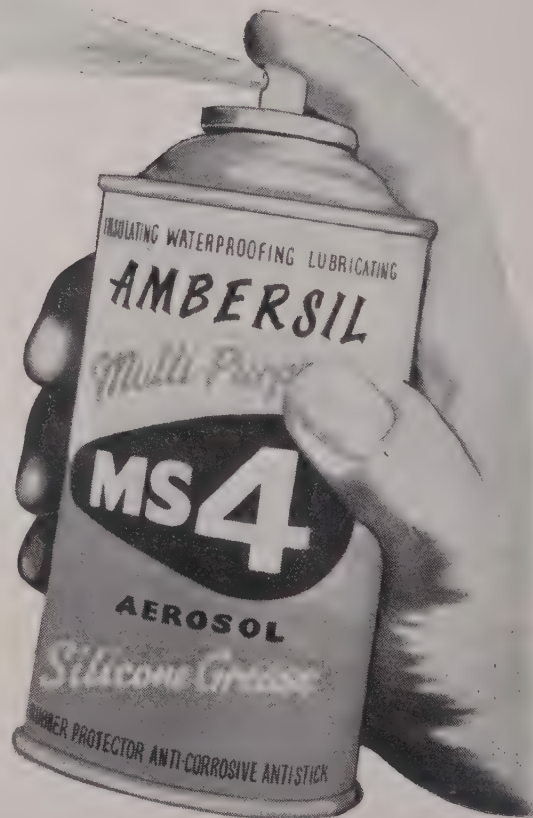
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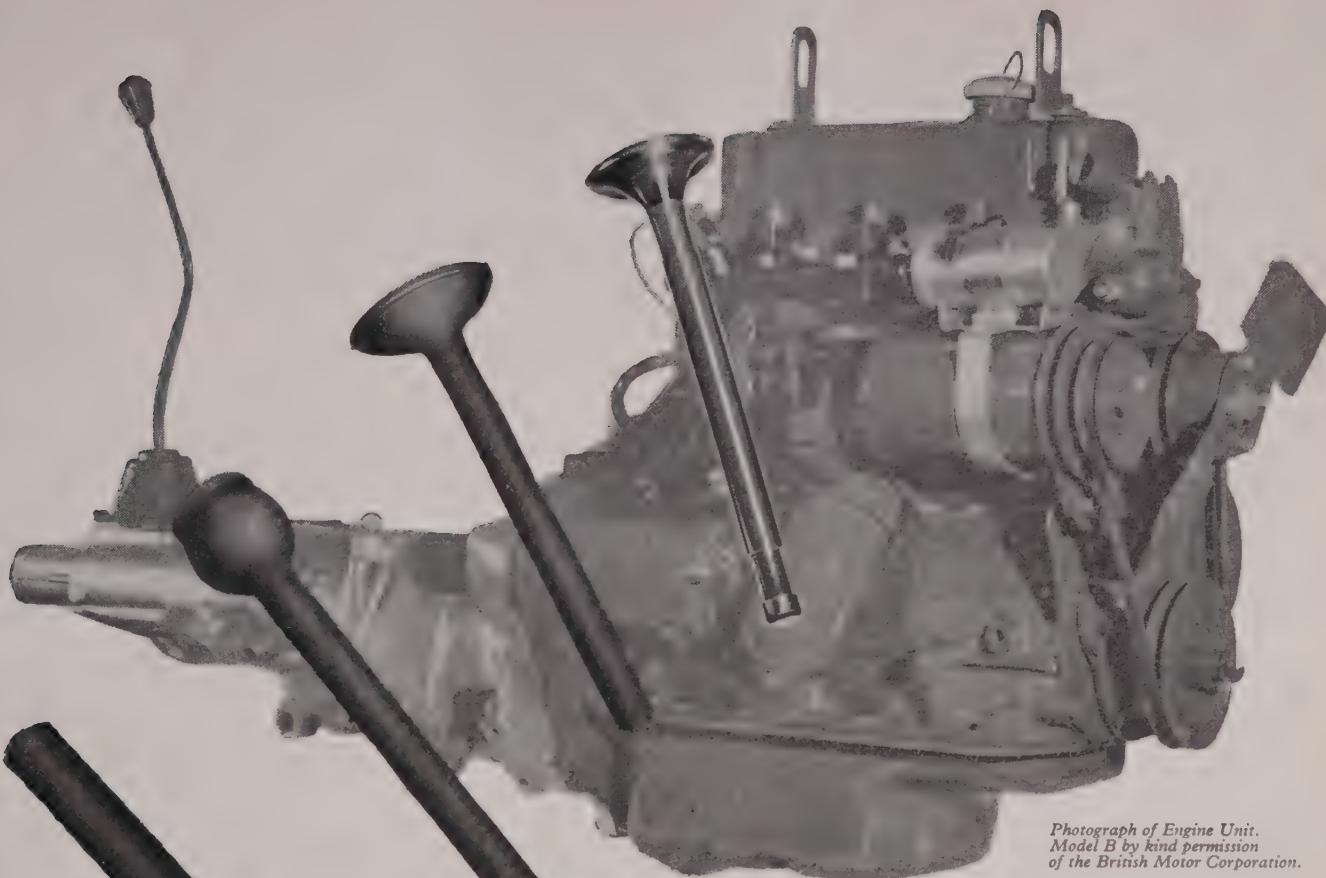
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*Photograph of Engine Unit.
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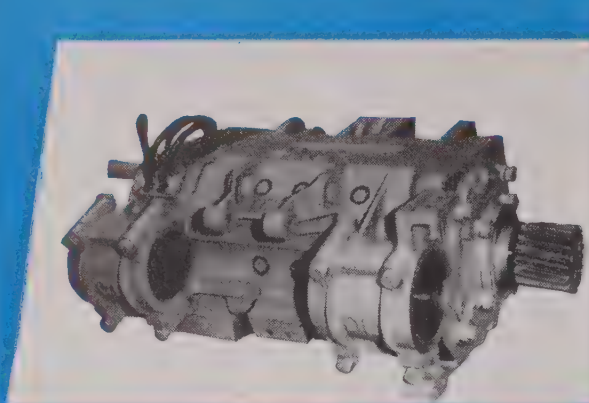
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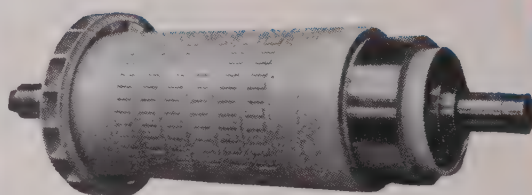
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A complete traction motor as being supplied for the new Piccadilly Line tube trains. Photograph by courtesy of The General Electric Co. Ltd., and London Transport.

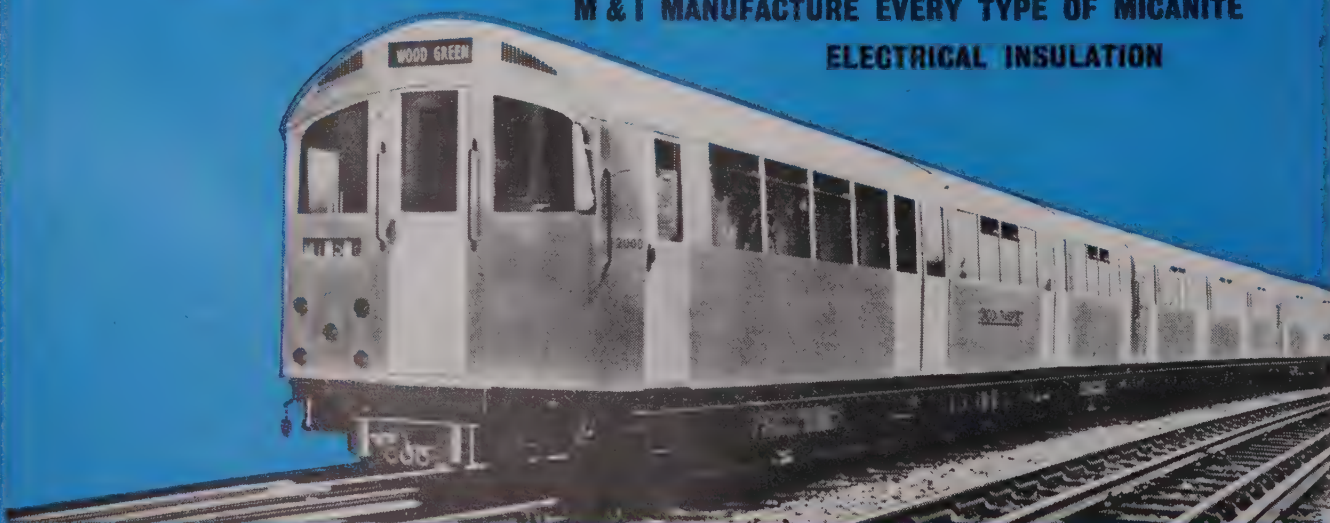


The armature of a traction motor for the new Piccadilly Line tube trains. Photograph by courtesy of The General Electric Co. Ltd., and London Transport.

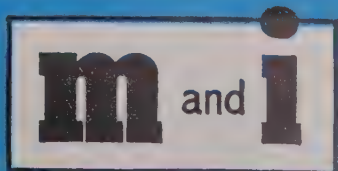
London Transport has placed orders for 76 seven-car trains for the Piccadilly Line at a cost of over £10,000,000. The main orders, the biggest for Underground trains since the war, were placed in 1958 and the first complete unit was delivered at the end of 1959. The remainder will be delivered by mid-1962 as part of a modernisation scheme to keep London's Underground up-to-date for its task of carrying nearly two million passengers a day.

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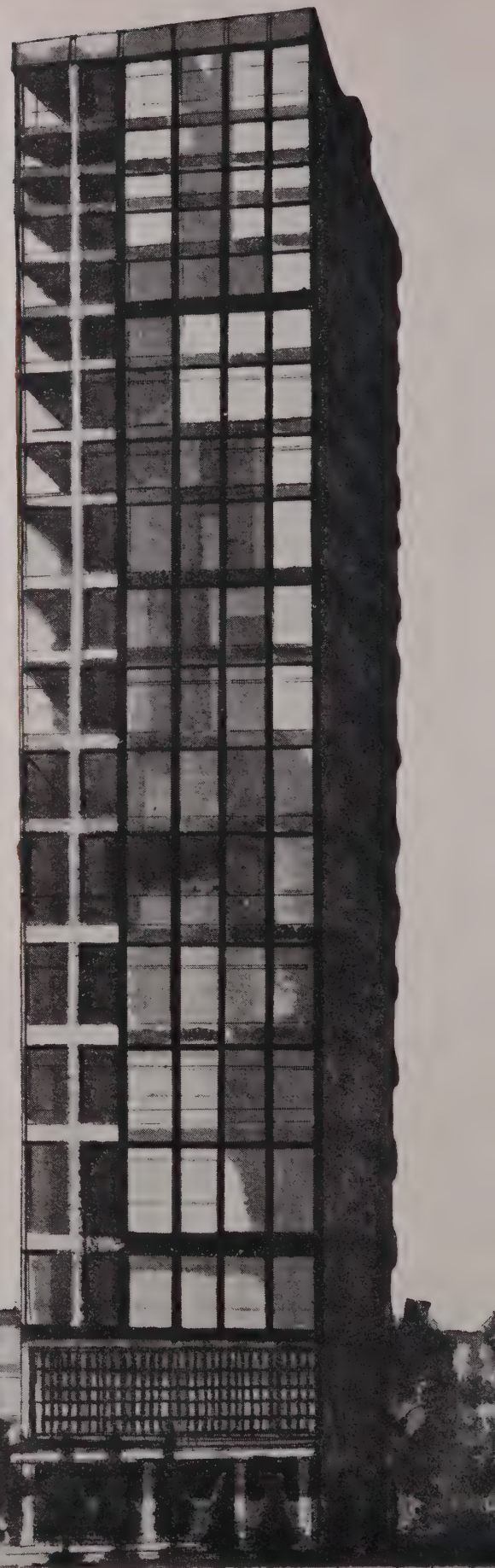
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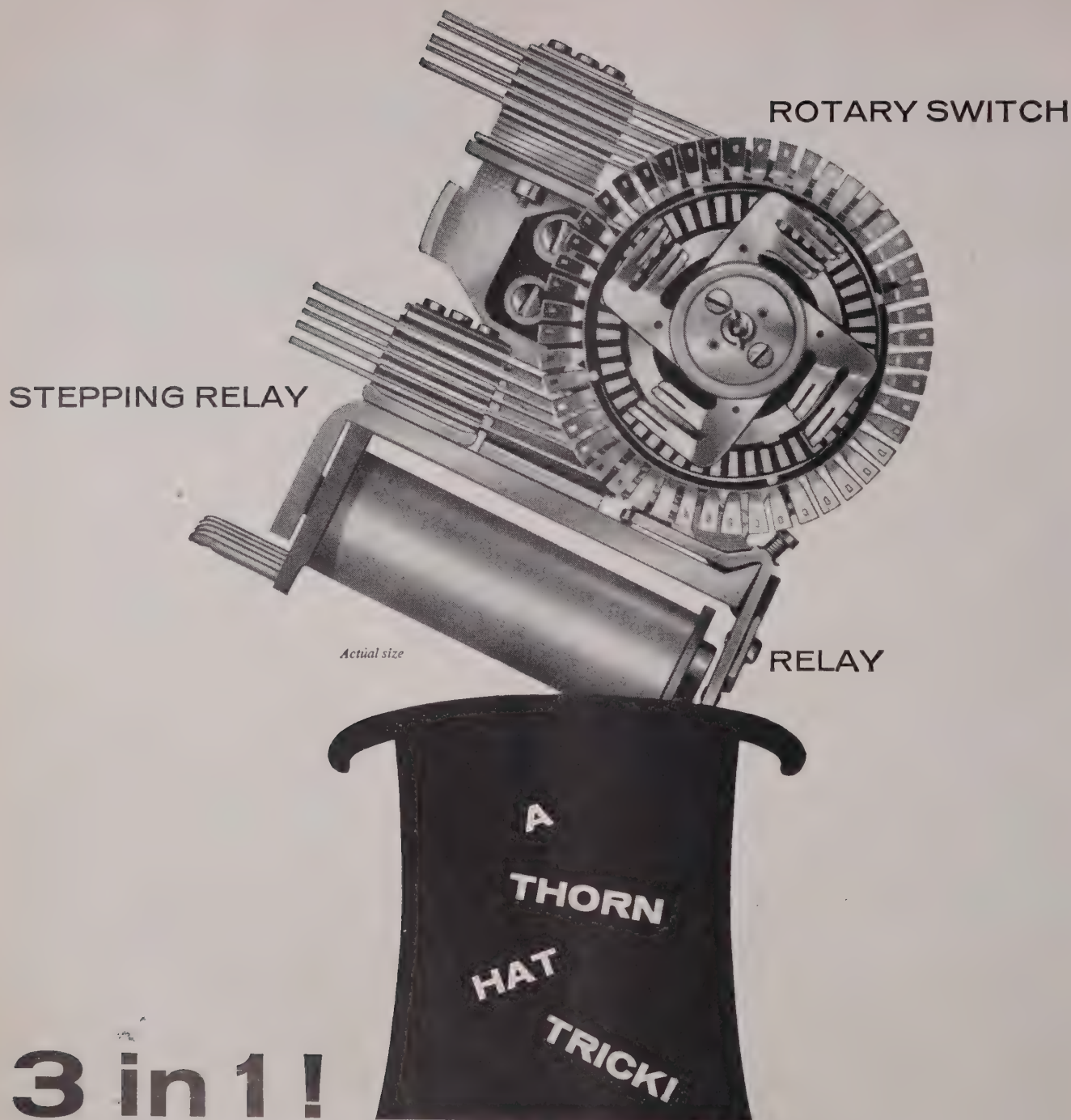


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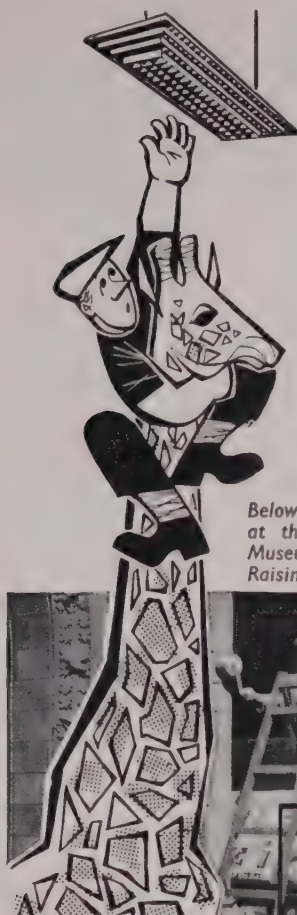
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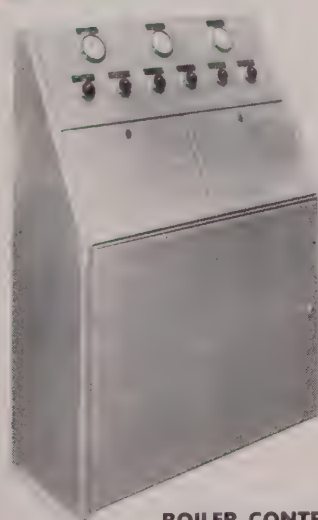


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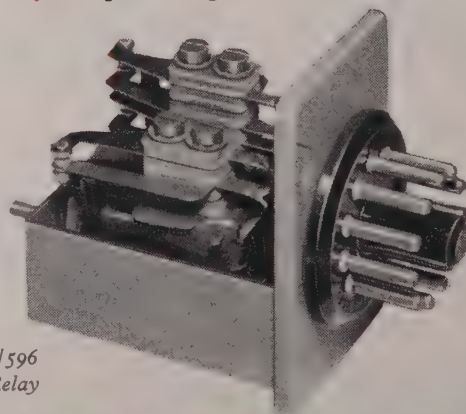
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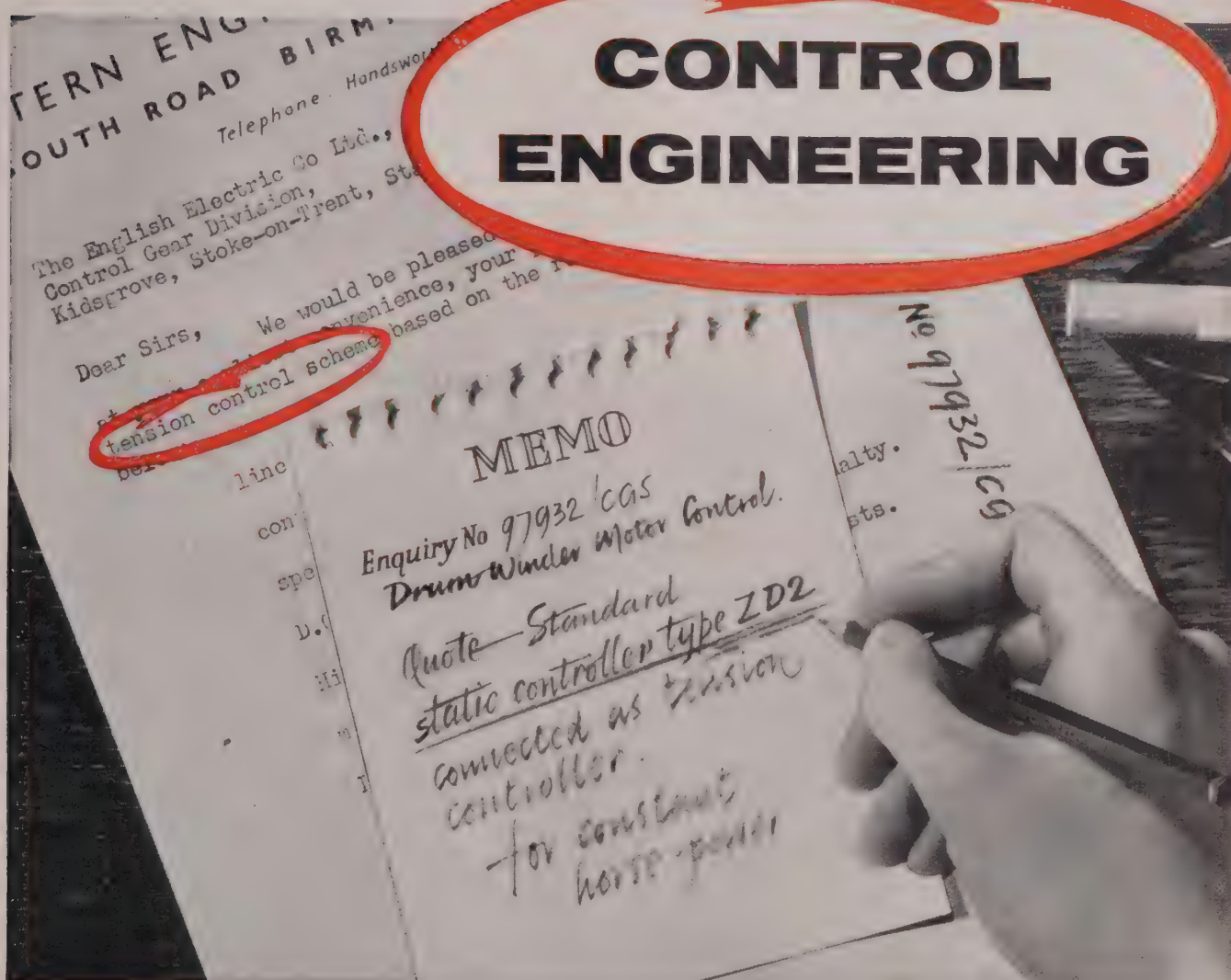
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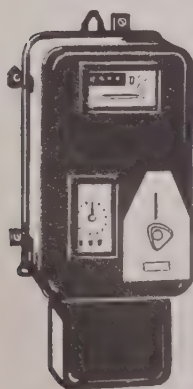
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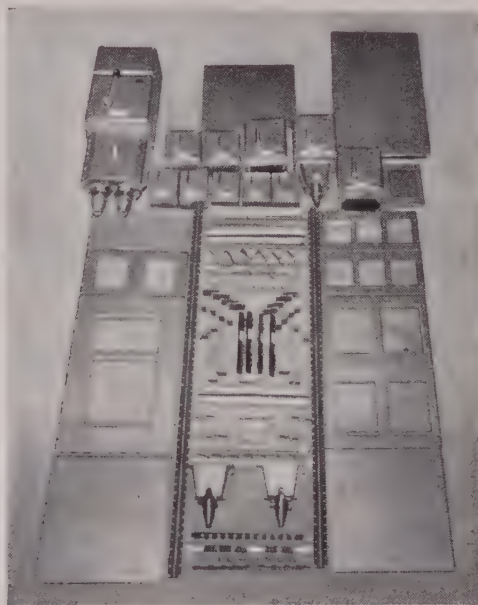
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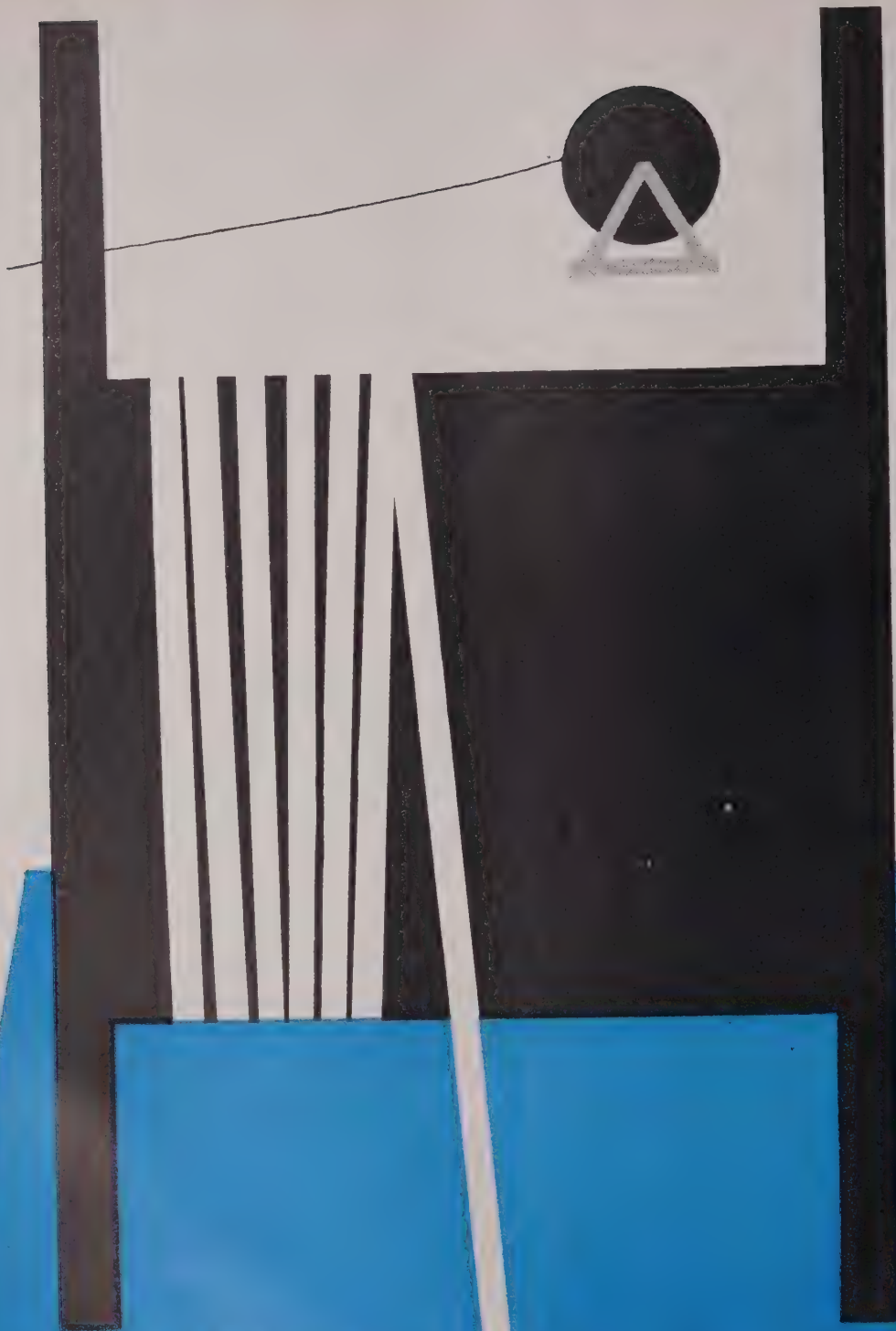
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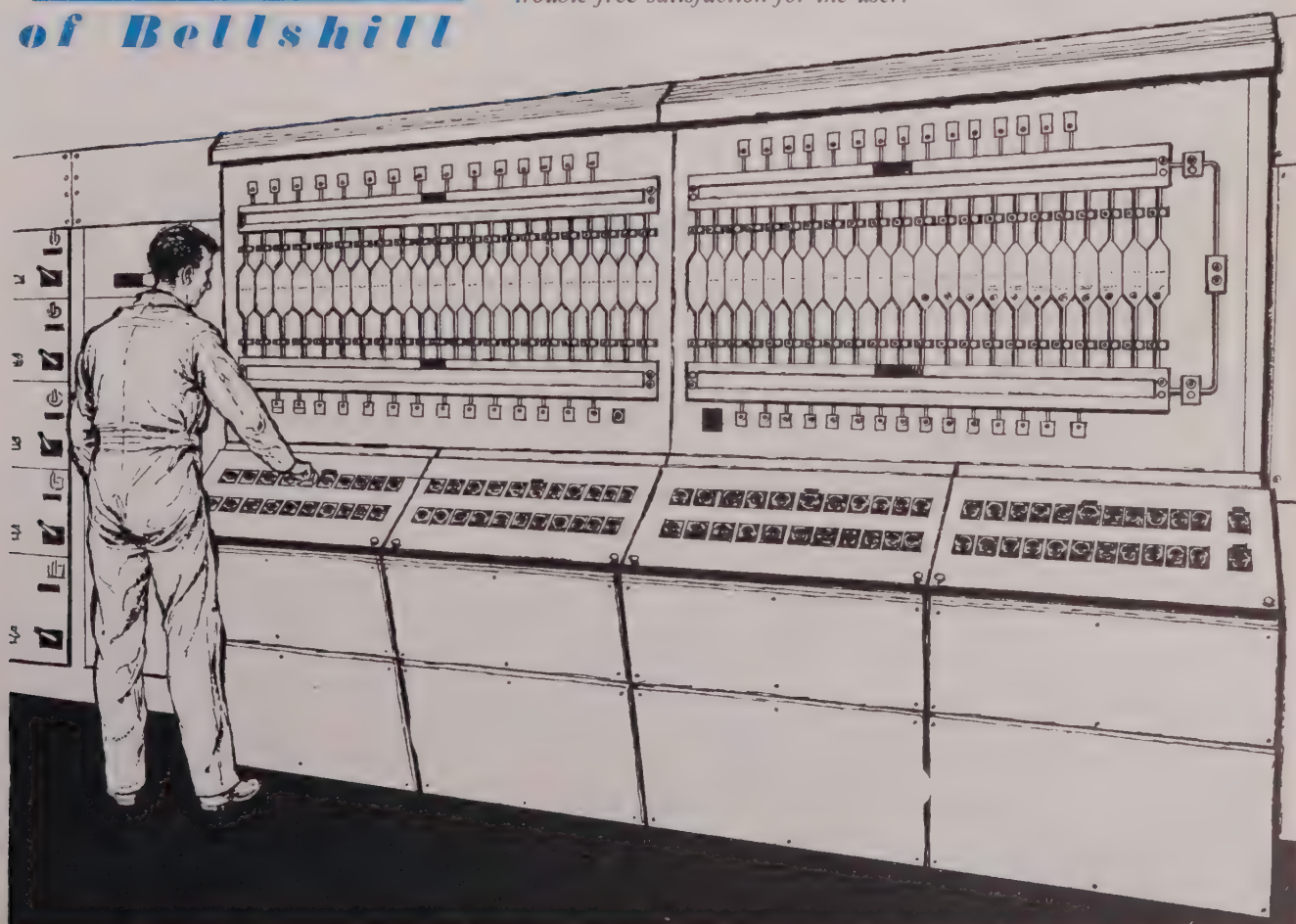
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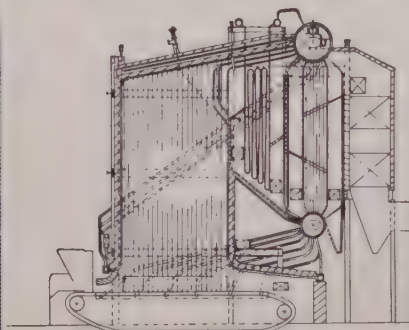
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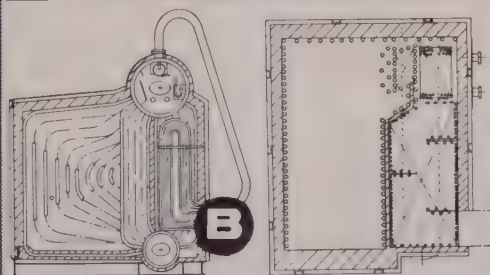
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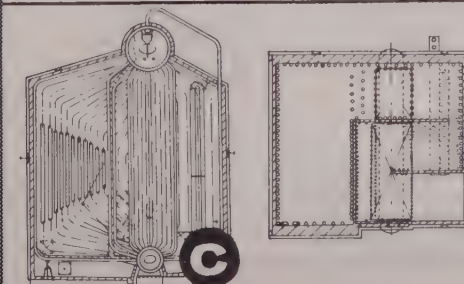
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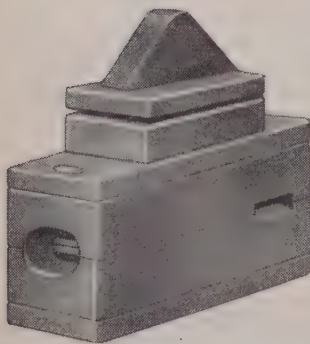
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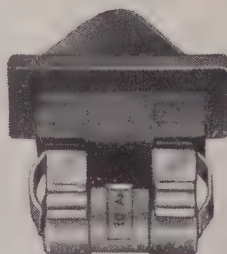
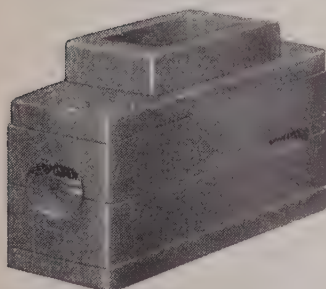


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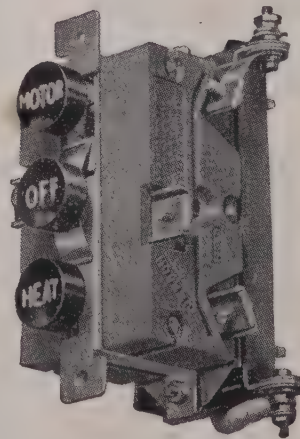
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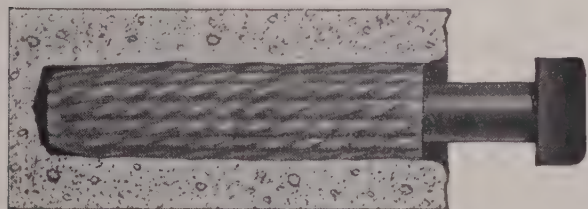
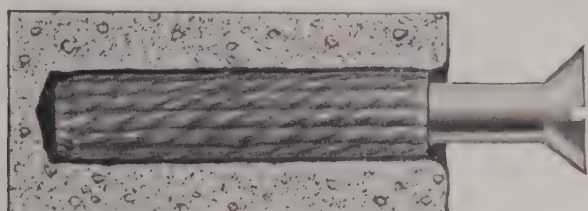
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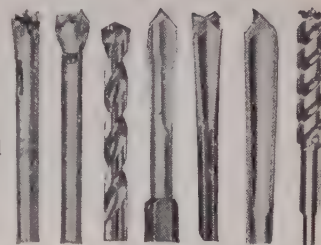
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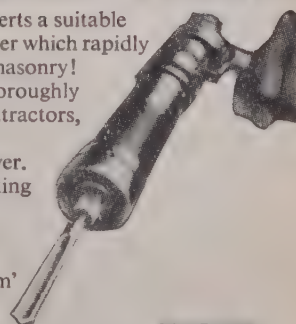


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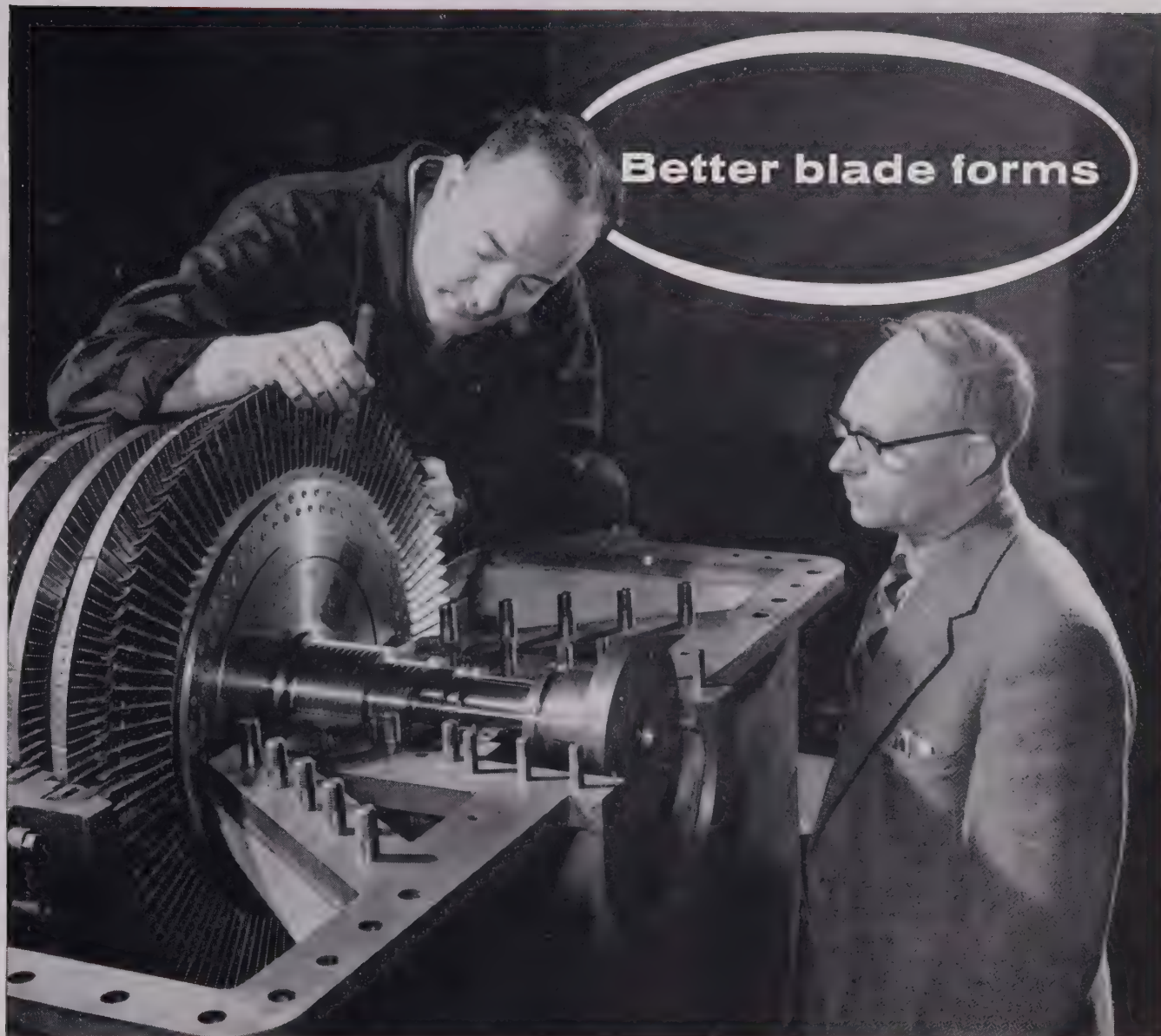
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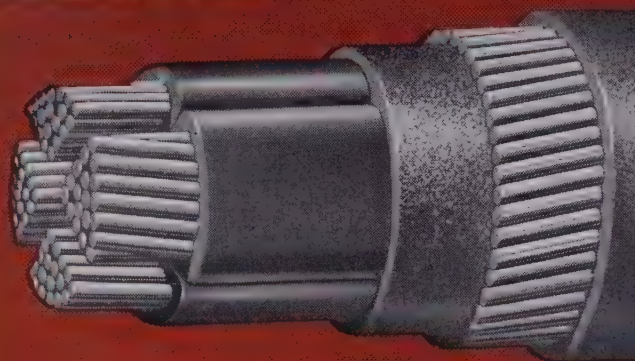
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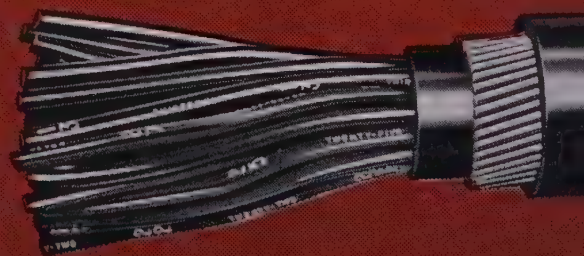
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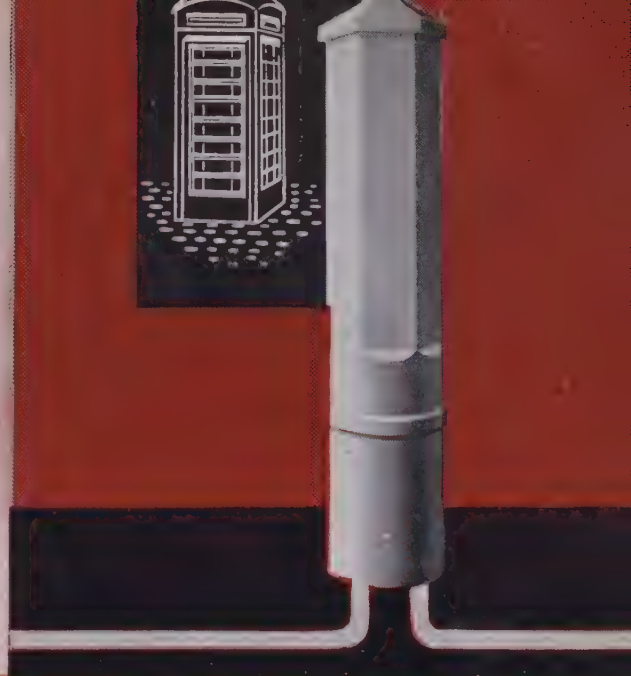
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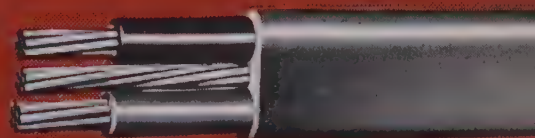


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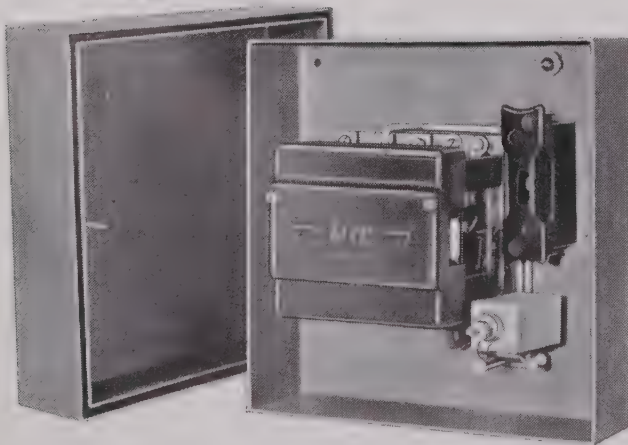
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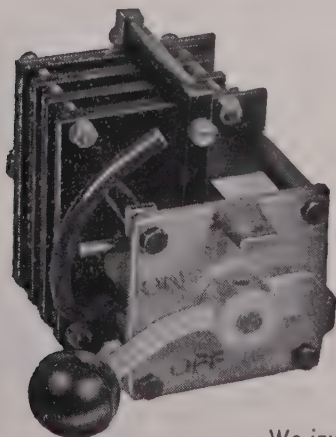
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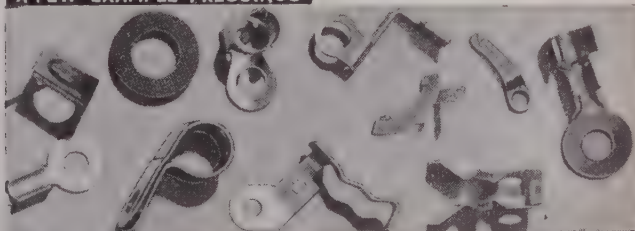
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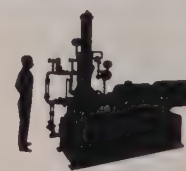
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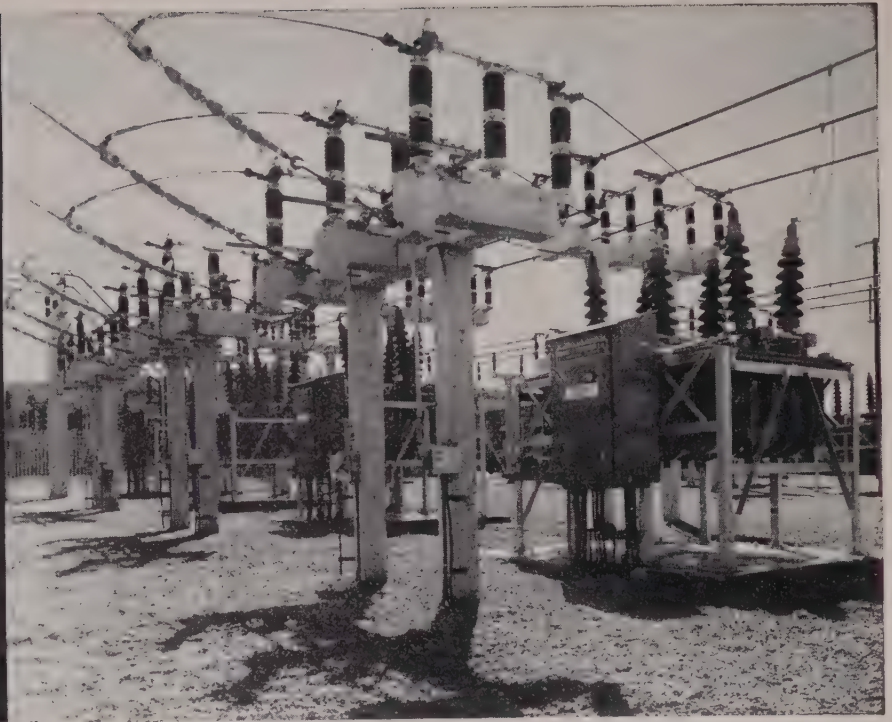
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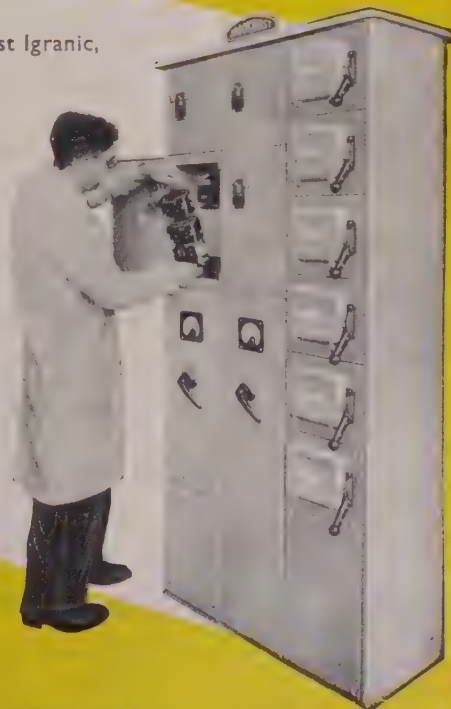
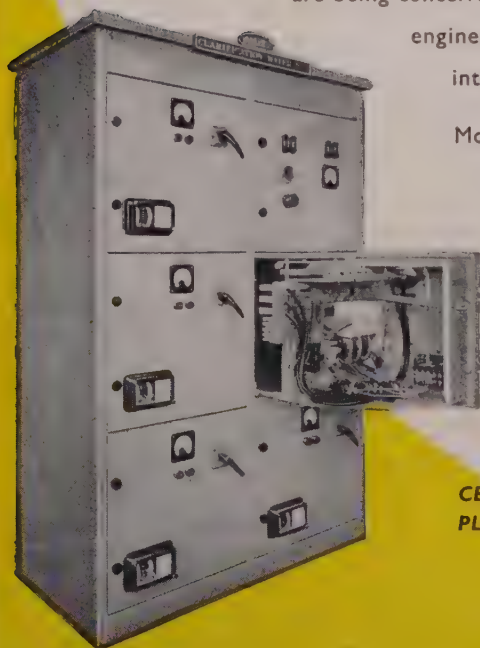
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processing plant through which it
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New British Standards FOR P.V.C. INSULATED CABLES as from 1st March 1961

B.S. 2004 : 1961

P.V.C. INSULATED CABLES AND FLEXIBLE CORDS

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B.S. 3346 : 1961

ARMoured P.V.C. INSULATED CABLES

This is a new British Standard, but it has been available for some time in draft form. We have been supplying cables to the new standard under the description "Cable to Draft B.S." or "D.B.S." The new British Standard number will be used for describing these cables as from 1st March 1961.

Note: The publication of the above Standards has unexpectedly been delayed and they may not be available in printed form for several weeks. They will, however, be regarded as applicable from 1st March 1961.



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ELECTRICAL REVIEW

Friday 10 March 1961 Volume 168 No 10

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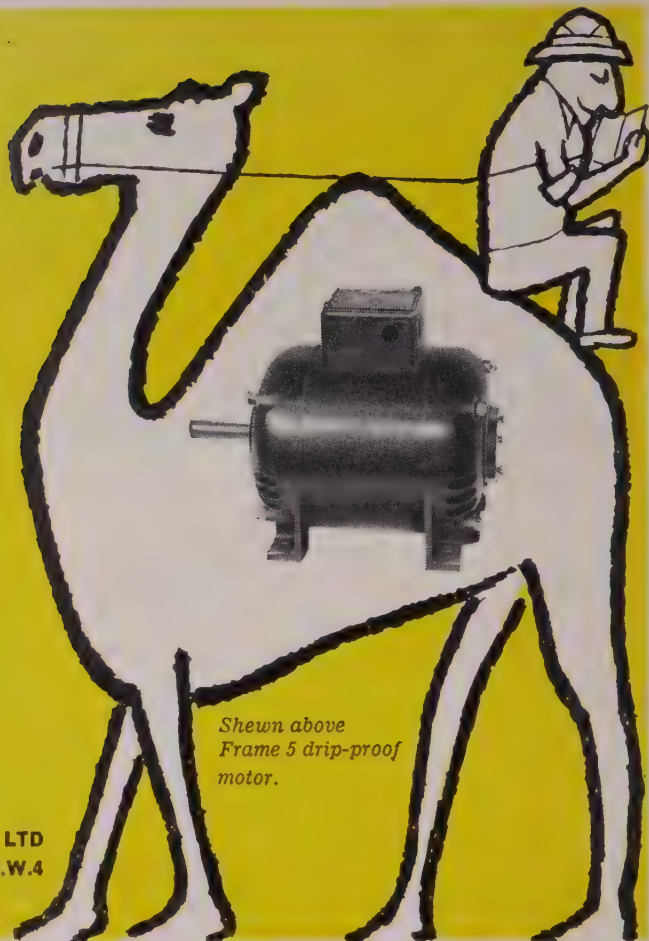
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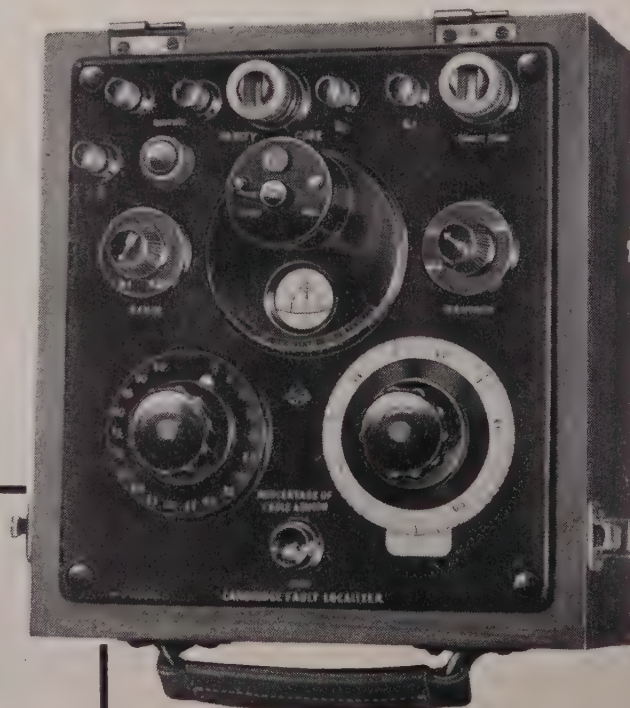
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ELECTRICAL REVIEW

10 March 1961 Vol. 168 No. 10 Established 1872

Sharing the Export Burden

LORD NELSON of Stafford has drawn attention to a most important aspect of the problem of increasing exports. In his annual address to shareholders of the English Electric Co., Ltd., he makes a strong plea for a reduction in costs by firms who supply his company with materials and components.

At present the responsibility for earning this country's living is borne directly by only a small section of the community. Most manufacturers are extremely secretive about their export earnings and precise figures for individual performance are difficult to obtain. Nevertheless, in our own industry it is reasonable to estimate that three companies—A.E.I., English Electric and G.E.C.—between them account for nearly 40 per cent of the total British and allied exports amounting to £290 million. Another thirty well-known exporters probably contribute a further quarter to a third.

Recently emphasis has been put on the need to stimulate "small" firms to seek business overseas. Yet it would seem evident that the extra earnings obtained from this source though worth striving for can be only a small part of the total. More could almost certainly be gained, more quickly and more lastingly, from assisting the efforts of those firms who already have established sales organisations overseas. They export not because exhorted to do so but because exporting is an essential part of their business. A single order lost here may represent a year's earnings of a host of smaller firms.

The measure needed to advance the exports of the major exporting companies go far deeper than reductions in surtax and other financial incentives, marginally important though these may be. Continental electrical manufacturers are consistently able to undersell us. But in paring prices to meet this competition a company like English Electric finds that 50 per cent of its own costs are for materials and components bought in. These have to be obtained in a home market that is relatively "soft," where the supplying companies do not face the highly competitive conditions that force the exporter to improve his efficiency and reduce his profit margin. As Lord Nelson has said, by concentrating on cost reduction these suppliers could share the responsibility of obtaining some of the

overseas business that is now being lost to foreign competitors.

Because of the stimulus it would give to efficiency in the home market, exporters increasingly believe that they would gain in the long run from a progressive lowering of this country's import tariffs. With the concentration of the industry into large groups it should also be easier to adopt policies that would promote greater efficiency in both exporters' own organisations and in other sectors of industry. The application of scientific and centralised purchasing techniques is an example. There is also great scope for the rationalisation of design and production so that the maximum use is made of a strictly limited range of parts and components. And home buyers can make a large contribution by not insisting on designs and standards that are increasingly difficult to sell abroad.

OVERHEAD OR UNDERGROUND?

Last week a joint conference was held in London of the Institution of the Rubber Industry and the Plastics Institute on "Rubber and Plastics in Cables." Most of the proceedings were concerned with chemical engineering but in one of the papers Sir Christopher Hinton had something to say about the problems involved in the transmission of electrical energy. Those attending the conference were largely concerned with manufacturing insulating materials and Sir Christopher told them that, irrespective of the amenity aspect, cable was really preferable to overhead conductors for transmission outside urban areas. He was, of course, emphasising the fact that the main objection to "undergrounding" is cost. It is not sufficiently widely known among those interested in "amenities" that an underground 275 kV cable costs seventeen times as much as an overhead line of the same capacity. In special cases, of course, the Central Electricity Generating Board does consider undergrounding, and because of this there is a need for the development of reliable cables capable of operating at 275 kV, 380 kV or even higher.

To avoid what Sir Christopher aptly called a "wirescape" for the transmission of power, there is a present need for the development of some means of bringing about a big reduction in the overall cost

of underground transmission. In view of the arguments which develop when each new transmission line is proposed, it is evident that the British public will not tolerate present transmission and distribution networks indefinitely. The solution seems to be underground cable at tolerable cost.

SKYSCRAPER INSTALLATION

The skyline of London is changing and so is that of most large towns and cities throughout the country. Large multi-storey office buildings and flats are becoming familiar and this means that architects and building contractors are prospering. The electrical contractors are involved in a great deal of work on the same account, and they encounter quite a few problems in providing for the concentrated loads which are created by these British skyscrapers.

A typical example of the sort of thing which is happening is the new *Daily Mirror* building, the electrical installation of which is described elsewhere in this issue. Admittedly, this building is not merely an office block: below ground level it accommodates the complete printing works of a national daily newspaper with a circulation of millions. Although the site has an area of only just over an acre, the construction of the building has created an electrical demand of some 7,500 kW. The amount of work involved can be judged from the fact that there are 6,000 lighting points, 450 miles of cable, 3,170 fluorescent fittings and 1,700 electric motors. Although many of these new buildings may be criticised for their appearance, they provide the office worker with an infinitely higher standard of accommodation than hitherto and they help to keep the electrical industry busy.

THE REVALUED MARK

Primarily, the increase of 5 per cent in the external value of the mark has been made to ease the strain on the United States' finances but it may also exercise a favourable influence upon our trade with Germany. The effect, of course, is to lower British prices in the German market and, conversely, to make imports from Germany dearer. Last year, from the electrical point of view, there was a balance adverse to us; exports to Western Germany amounted to £6.7 million and imports from that country to £9.3 million. While for the same volume of trade both ways the difference would, of course, be even greater, with the new rate of exchange the tendency should be towards an increase in exports to Western Germany and a decrease in imports. The present trade drive being sponsored by the B.E.A.M.A. should thus be assisted by the revaluation, if only to a small extent.

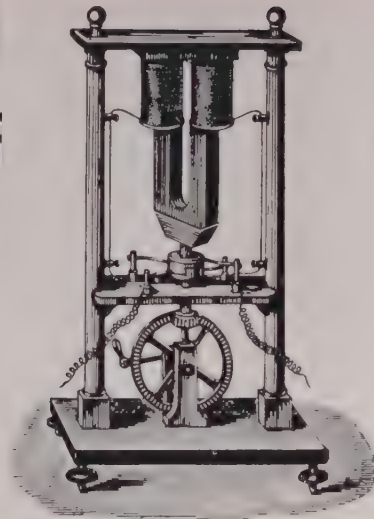
ELECTRICAL ENGINEERS EXHIBITION

A stand-by-stand preview of the Electrical Engineers Exhibition at Earls Court, London (21st — 25th March) will be given in next week's issue of the *Electrical Review*. The issue will also contain a description of the Communications feature, typifying this year's theme of the exhibition, and a brief summary of some of the other interesting exhibits shown by over 470 manufacturers, associations and other organisations. The exhibition will be open from 10 a.m. to 7 p.m.

(Wednesday 9 p.m.), admission by ticket or trade card

EVOLUTION OF

ELECTROMAGNETIC MACHINES



By E. KUFFEL, M.Sc., Ph.D.

The progress of electric motors and generators is traced from early experimental machines to present-day power plant, concluding with a study of prototype motors now being developed. A representative selection of the machines described will be shown at the forthcoming Electrical Engineers Exhibition by Pinchin, Johnson & Co., who originally requested the author to make the study on which this article is based

IN 1820 Oersted noticed that a compass needle was deflected when placed near a conductor carrying an electric current, and then demonstrated the converse effect, the deflection of an electric current by a magnet. A year later, as a result of Oersted's discoveries, Faraday invented the first "d.c. motor," producing the continuous motion of a current-carrying conductor placed in a magnetic field. The reverse process, that is generation of electric current in conductors by moving them in magnetic fields, was discovered exactly ten years later, again by Faraday.

During the next 20 years several types of motors were invented in this country, on the Continent and in America, but as long as the source of current was limited to batteries the electric motor remained uneconomical in comparison with the steam engine.

Early dynamos employed permanent magnets as rotors and Fig. 1 shows the electromagnetic machine which Pixi constructed in 1832. This is probably the earliest of its type. It employed a crank to impart motion to a magnet fastened to the top of the upright shaft by means of bevel gear wheels. The magnetic changes produced in the core of the electromagnet induced currents in the wire coils which were then conducted to the commutator by the wires shown alongside the frame. The simple commutator made two changes in direction of current for each revolution. To increase the output the general technique was to increase the number of permanent magnets and the number of coils.

Practical Machines

A big advance was made in the construction of electrical machines by the introduction of an armature by Siemens

in 1856 (see Fig. 2) which was placed between the poles of permanent magnets. In its original form the armature consisted of a cylinder of soft iron with grooves in opposite sides wound with insulated wires. The magnets had to be long compared with their cross-section in order to be reasonably permanent. Fifteen years later Siemens introduced wooden drum armatures overlaid with iron wires which were like an expanded Gramme ring winding.

The most revolutionary step forward in electromagnetic machine design was the replacement of permanent magnets by electromagnets (Siemens, 1866, and independently by Wheatstone). The earliest electromagnets consisted of one or more soft iron horse-shoes surrounded by insulated wire, and the armature consisted of soft iron with insulated wires and a commutator. A further advance was made by Wilde who was the first to introduce the idea of an exciter in 1866. His machine consisted of two Siemens armatures. The current from the first armature was conducted

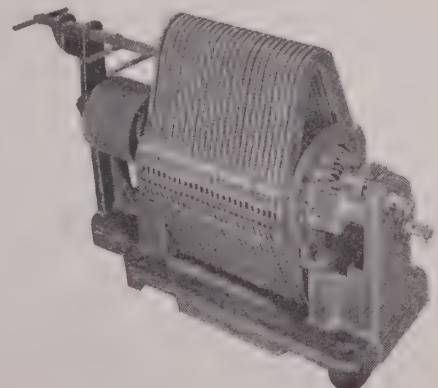


Fig. 2.—Siemens' dynamo (1856)

Title picture: Fig. 1.—Pixi's generator (1832)

through the coils of the larger electromagnet and the current from the second was used for electric lighting.

It was soon realised that the electromagnetic machine was fully reversible, capable of transforming mechanical power into electrical and vice versa, and the electric motor began to be studied carefully. In 1870, Gramme, a Belgian working in France, introduced the d.c. machine with his famous ring (see Fig. 3). This consisted of soft iron wires wound on a mould into a ring to serve as a core. On this core separate sections of copper wire were wound. The end of each coil and the beginning of the next one,

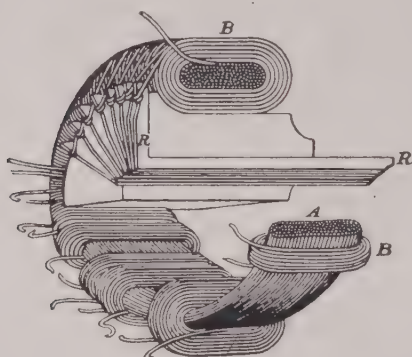


Fig. 3.—Gramme's ring (1870)

were connected to one another and to an insulated radial piece of copper (R), which formed one bar of the collector. A great number of Gramme's machines were made, varying from small laboratory machines with permanent magnets to large machines rated at 30 to 40 h.p.

Electric Lighting Arrives

Although the brightness of an electric arc discharge was demonstrated by Sir Humphrey Davy in 1808, the arc was not seriously considered as a source of illumination until the advent of the dynamo. By the middle of the 1870's, illumination by electric arcs was well established and the scope of electric lighting was growing rapidly. Public supply did not exist then and every lighting installation was independent. By 1880 a number of British and Continental theatres and opera houses had electric lighting, the generators generally being driven by steam engines. In France, Gramme dynamos were the most popular, while in Britain, the Siemens and the Wheatstone machines predominated. At the same time Crompton, of Chelmsford, started manufacturing complete electric plants together with self-regulating arc lamps. Meanwhile, Swan, who had been experimenting with carbon filament lamps since 1860, brought the incandescent lamp to a practical stage. Concurrently, Edison, working independently in America, solved the problem of operating incandescent lamps in parallel.

The leading personalities in the then young electrical industry quickly realised the vast potentialities of electric power and concentrated on development of new types of generators. The problems of design were complicated by the scarcity of knowledge on electrical subjects. Electrical phenomena such as current, voltage and resistance were known but had no accepted standards. Formulae for calculations did not exist and design problems had to be

solved by trial and error. At an international conference in Paris in 1881 the definitions of ampère for current, volt for electro-motive force, watt for energy and ohm for resistance were established.

By that time several young enthusiasts had already succeeded in establishing their authority in electrical matters. The pioneering work on electrical machines included the names of Siemens, Hopkinson, Crompton, Edison, Ferranti and many others. In 1883 Crompton brought out his famous "heavy current" generator which remained in operation for many years. The outstanding feature of that generator (Fig. 4) was the combination of series and shunt field windings, thus originating the compound wound machine. The magnets were made of very soft Swedish wrought iron. The armature was a single ring of an elongated cylindrical pattern and its coils were wound upon an iron core made up of discs of very thin soft iron fixed upon a central spindle by means of short arms.

With the advent of the incandescent filament lamps the prospect of lighting houses, shops and streets increased. It was already realised that the problem could only be solved by building central generating stations supplying a whole district. Consequently, methods had to be devised of carrying heavy currents over a distance. Crompton introduced an underground system consisting of tubular

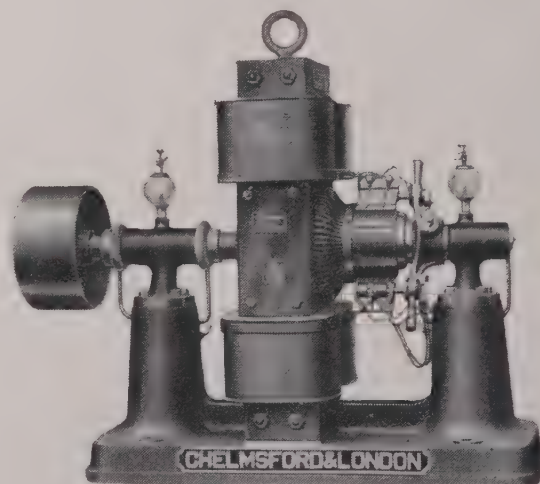


Fig. 4.—Crompton's generator (1833)

copper conductors insulated with glass and vitreous enamel. To provide a continuous supply of electricity for a light load when the main plant was shut down at night, he employed accumulators consisting of very large, active lead-plate surfaces immersed in an electrolyte.

Parallel with Crompton's developments in this country, Edison invented a heavy current machine which differed somewhat from its contemporaries. It was based on the same principle as the other machines discussed, but the field magnets were of extraordinary size and shape. The cores of these magnets were wrought iron cylinders, 1 to 2 metres long, wound with insulated copper wire and provided with massive pole pieces of cast iron which encircled the armature of the machine (see Fig. 5). Several modified types followed, differing mainly in the size and the disposition of the large cylindrical magnets.

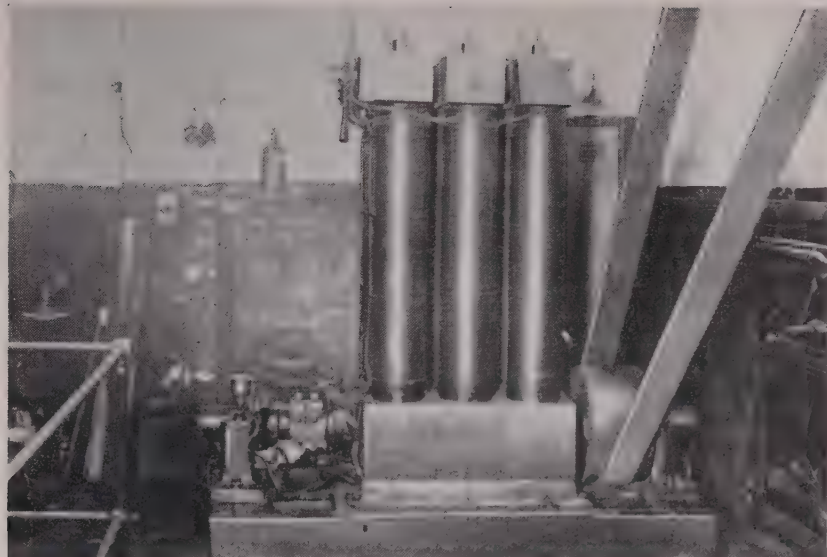


Fig. 5.—Edison heavy current machine (1882)

In the late 1870's the first scientific information on electrical machines came from John Hopkinson, who had already established his reputation in other fields of engineering and science. He made the first experimental studies of the existing types of machines and was able to analyse their design and performance mathematically. One of his famous experiments was the back-to-back method of determining the efficiency of two identical machines. He subsequently succeeded in making direct comparison of the measured characteristics of electrical machines with those predicted from a knowledge of electromagnetic laws and the properties of iron.

In the early 1880's Hopkinson accepted an appointment as a consultant with Mather & Platt, Ltd., of Manchester, who then held the licence for manufacturing the Edison dynamo in this country. He immediately realised the inefficiency of that dynamo because of the poor arrangement of its field system. He therefore redesigned it by diminishing the length and increasing the cross-section of the magnetic circuit. The first machine of the new design

gave more than double the output of the Edison machine of the same weight. In 1883 dynamos rated up to 31.9 kW were produced. A year later Hopkinson designed the well-known Manchester dynamo incorporating a magnetic circuit in a closed ring. This was the first stage in the evolution of the multi-polar machine (see Fig. 6).

While Crompton and Hopkinson explored the field of continuous current dynamos, and Crompton proposed a supply at 400 to 500 V by direct current generators in conjunction with large batteries, a young engineer named Ferranti advocated alternating current, generated at high voltage and transformed to a lower voltage for actual use.

At the beginning of 1880, while Ferranti was in employment with Siemens, he invented a new type of alternator with a zig-zag armature, later known as the Ferranti-Thomson alternator (see Fig. 7). The feature of this machine was the absence of iron in the revolving armature which greatly decreased the weight and enabled the magnets to be brought together, thus increasing the efficiency. This

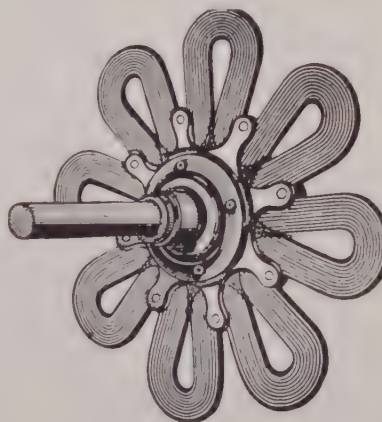


Fig. 7.—Armature of Ferranti alternator (1880)

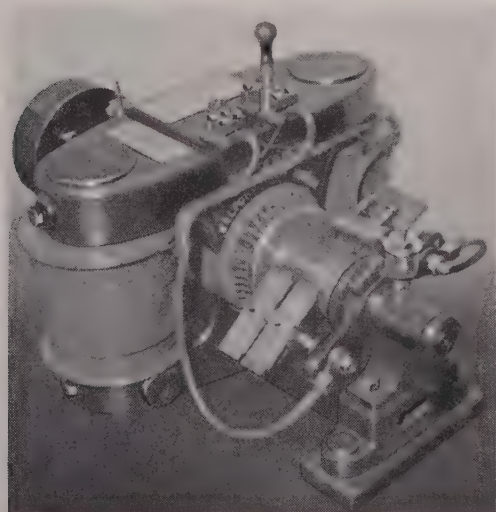


Fig. 6.—Manchester dynamo (1884)

increased efficiency was aided by the abolition of the commutator. The alternator gave five times as much light as machines of the same size at that time and it is interesting to note that output was then estimated by the number of lamps a machine could conveniently supply.

In addition to improving generating plant, Ferranti designed transformers of various sizes. He suggested the principle that power should be generated on a big scale, outside the great centres, where land was cheap and water and coal easily available. Soon, the construction of the first large-scale power station started at Deptford and was successfully completed in 1888. Here Ferranti was wholly responsible for the design and construction. Machines of 10,000 h.p., completely unfamiliar in those days, were installed, with the system operating at 10 kV. The high

voltage line used for transmission consisted of concentric copper tubes separated by paper insulation, the outside being again insulated and the whole inserted into an iron tube. The mains were laid down in 20ft lengths.

In 1884, Parsons was engaged in the development of steam turbines and he constructed the first turbo-generator, with a power output of $7\frac{1}{2}$ kW when running at 18,000 r.p.m. By 1891 he was making machines of 100 kW output, incorporating turbines fitted with condensers.

At about the same time (1887-88) two-phase and three-phase alternators and induction motors were patented by Tesla, thus inaugurating polyphase electrical engineering, and only three years later, three-phase overhead electric transmission was installed between Laufen and Frankfurt, a distance of 110 miles, the transformers being oil cooled for the first time.

The Age of Electricity

By the end of the century electric lighting and power were well established, though on a small scale, and most of the principles essential to designers had been evolved.

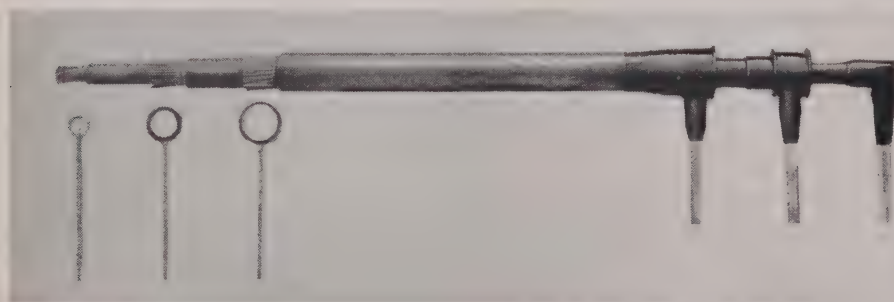


Fig. 8.—Parsons' high-voltage conductor bar, showing method of joining conductors and end windings (1928)

A number of factories had installed electric lights and had changed to electric motors. Progress since then has largely resulted from steady technical improvements in design, from the use of improved materials and improved organisation. The coal mining industry was first to realise the advantages of electricity, for lighting and for power. The demands for electric power were growing rapidly, but the lines along which progress would take place were not clearly evident. The system of the three-phase turbo-generator producing high-voltage power in the central stations was by no means unique and direct current systems with storage batteries were equally common.

By 1910 the general pattern of the future electrical machines had been set. The introduction of interpoles about 1905 solved a number of commutation problems. In the field of electrical generators the constantly increasing demand for power called for machines of larger output and improved efficiency. The driving power was generally obtained by means of steam and hydraulic turbines. The latter were first introduced in 1891 on the Frankfurt-Laufen scheme.

The parallel development of d.c. and a.c. generating stations, which continued up to the period of 1914, led to much confusion. In 1918 a co-ordinating body was established to organise electricity supply, by centralising generating stations in a limited number of areas, all of which would be connected by a common high-voltage grid system. The task was tremendous, and the progress was complicated by the differences in the systems of supply. Some idea of how bad the conditions were can be gained

from the fact that in the Greater London area alone in 1921 there were over 80 separate supply authorities with 70 different generating stations. In the same area there were 50 different systems of supply operating at 24 different voltages and 10 different frequencies.

Subsequent developments generally favoured a.c. systems and, for economic reasons, generating stations were usually erected on sites where coal was cheap and where an abundant water supply was available. This meant that power had to be transmitted over long distances and therefore at high voltage. The general practice was to step up the voltage by means of a transformer situated in the generating station.

An alternative method was to generate at high voltage. Several manufacturers specialised in the development of high-voltage alternators, notably C. A. Parsons & Co., Ltd., who, in 1928, placed in operation a turbo-generator generating at 36 kV. The special feature of the high-voltage generators was that their conductors were arranged concentrically (see Fig. 8) and thus permitted the generation of high voltage without exceeding the stress involved

in a machine of normal voltage. One of the factors which limits the output of a large machine is the highest permissible working temperature. Excessive heat will cause deterioration of the insulation. Manufacturers of insulating materials have produced products capable of withstanding greatly increased temperatures, but cooling remains one of the most important problems in the development of large generators. In the case of small alternators, the practice for many years was to fit fans at the ends of the rotors which caused air flow through the gap between the rotor and the stator. Since the 1930's there has been an increased tendency to cool large machines with hydrogen, because of its much greater thermal conductivity compared with air. The induction motor came into general use at the very beginning of the twentieth century, and different sizes and different types of these



Fig. 9.—Mather & Platt motor (1912)

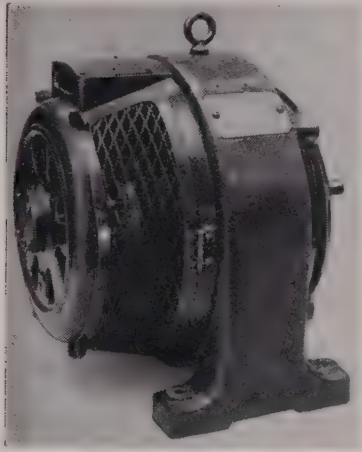


Fig. 10.—Crompton's d.c. motor (1923)

as well as d.c. motors appeared. Up to about 1920 the general characteristics remained unaltered. A typical example is shown in Fig. 9, which is a Mather & Platt 1912 motor of $4\frac{1}{2}$ b.h.p., 440 V. The machine is already fitted with inter-poles and it has a cast steel frame and a direct ventilation system, with a fan and enclosing cover at the driving end.

The next example (Fig. 10) is an enclosed ventilated d.c. motor of 1923, a 5 h.p. Crompton machine, much reduced in size. It is a four-pole shunt-wound machine, fitted with interpoles, and a drum-wound armature.

Finally, Fig. 11 shows a model of a modern waterwheel generator, one of the six 16 MW generators put into service in 1960 in the new McKay Creek hydro-electric power station on Kiewa River, Victoria, Australia, by Associated Electrical Industries, Ltd. Water for the turbines is conveyed through three miles of tunnel, then by surface pipelines and finally through a 630ft steel-lined pressure tunnel. The turbines work under a head of more than 1,700ft.

Variable-Speed Induction Motor

A new series of motors recently developed by Prof. F. C. Williams and his collaborators,^{1, 2} which at present are still in the experimental stage, are the variable-speed linear induction motors. These are based on the principle that a piece of conducting material, placed in a varying magnetic field, can be caused to move at a speed in excess of the speed of the field, by constraining it to move at an angle to the direction of motion of the field.

The simplest example would be a conducting sheet threaded by a magnetic field. If the sheet were allowed to move parallel to the field, it would assume a velocity equal to that of the field, which is the principle of the squirrel-cage induction motor. If the sheet is now constrained so that it can move only in its own plane, and in a direction making an angle with the direction of motion of the field, then the sheet is found to travel at speeds in excess of the speed of the field.

The disadvantage of the conventional squirrel-cage induction motor is that it is essentially a constant-speed motor. To obtain variable-speed motors, two lines of research have been explored: pole changing, and drawing power from, or injecting power into, the rotor. The first yields a small number of discrete speeds, whereas the second may give continuous speed variation but at the cost of substituting a wound rotor and a commutator or slip ring. The new method has some relation to the pole-

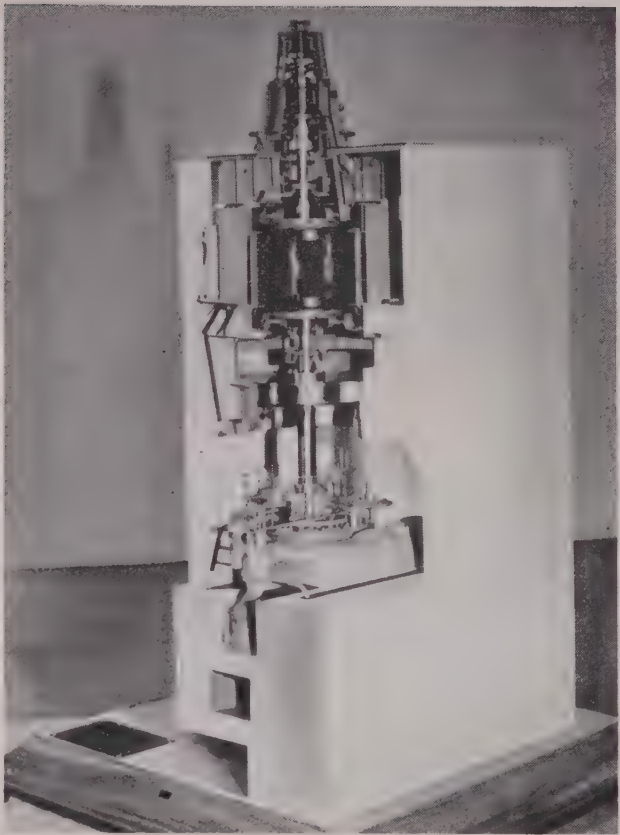
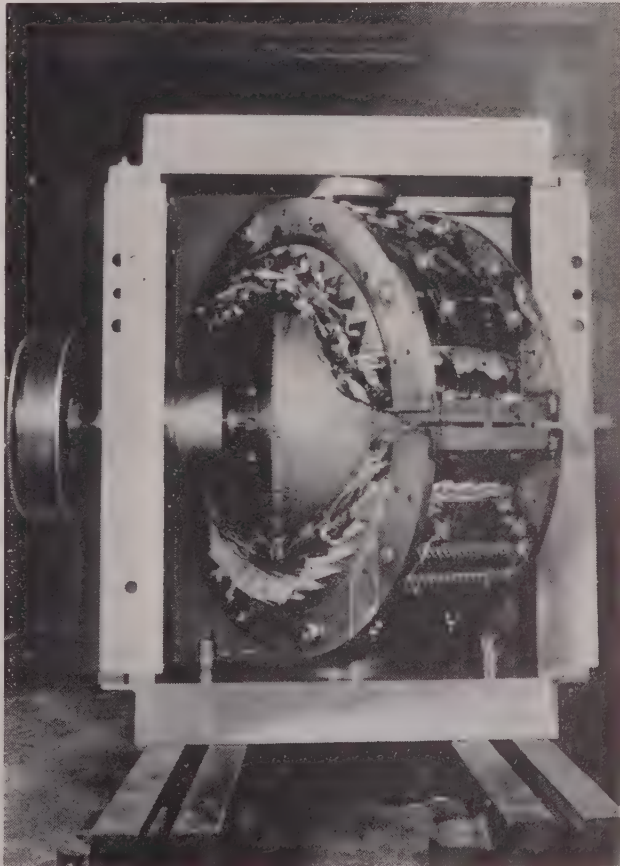


Fig. 11.—Waterwheel generator model (1960)

Fig. 12.—Spherical induction motor



changing method, but it does not involve any mechanical separation of the poles or switching of windings; there are no switches and no rubbing contacts.

Several types of motors based on the new principle have already been successfully developed, the first of the series, shown in Fig. 12, being the spherical motor. This is a brushless variable-speed motor in which speed change is effected by changing the angle between the direction of movement of the magnetic field and that of the rotor. This involves the use of spherical surfaces for both rotor and stator and the rotor contains conductors in two directions in the form of a conductor "grid." In Fig. 13 is shown another type of the same series of motors, referred to as the "logmotor." This is a continuously variable-speed induction motor in which the phase of the current in

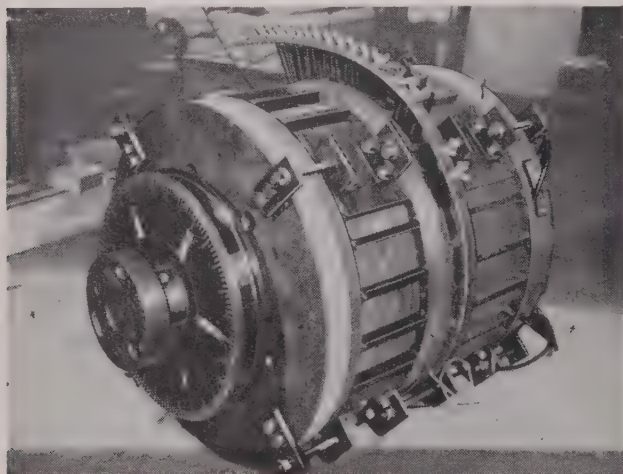


Fig. 13.—(Above) The 'Logmotor'
(Right) Exploded view of the machine

each slot of the stator can be continuously changed in an organised manner by means of a phase shifting transformer. The polyphase primary winding of the phase shifter is so arranged that successive pole pitches around the periphery form a logarithmic sequence. The secondary winding of the phase shifter consists of single conductors in slots, all connected to a common ring at one end. Again the slotting is arranged in a logarithmic sequence. The free ends of the conductors are connected to free ends of a set of conductors in the slots of the motor stator, the other ends of which are connected to a common ring. Thus the primary and the secondary winding of the phase shifter are arranged like the C and D scales on a slide rule, so that the movement of one relative to the other produces a different pole pitch on the motor stator, thereby changing the speed of the field.

Insulating Materials

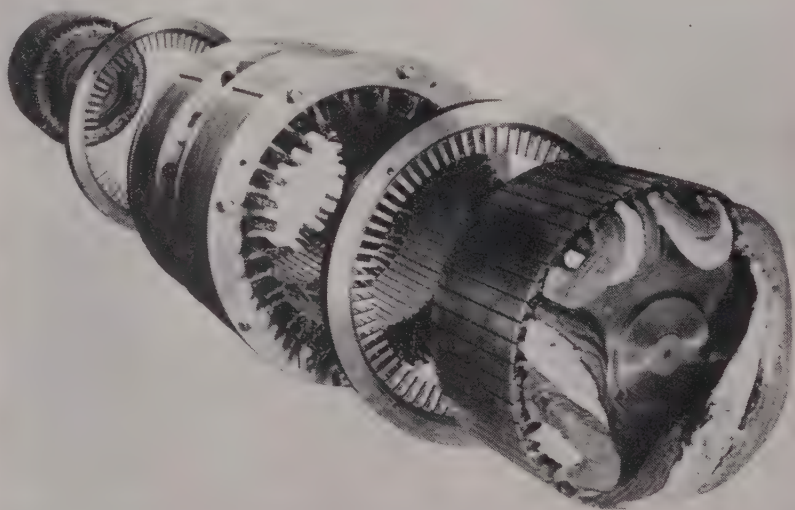
The design and application of electrical insulating materials has now progressed far beyond the simple requirements demanded by the electromagnetic apparatus and machines of the early half of the nineteenth century. The prime need was, as now, to prevent the leakage of

current, either between turns of wire in a coil, or conducting leads to earth.

Michael Faraday employed calico and twine to insulate turns of copper wire in his iron ring experiment in 1831; Francis Ronalds used glass tubing for insulating underground conductors in his "static" telegraph experiments in 1816, and William Fothergill Cooke, together with Charles Wheatstone, used wires embedded in timber and treated with tar for the buried "cables" of the first inland telegraph system in 1837-38.

The treatment of copper wire with cotton and silk became established in 1835; coil cheeks and terminal blocks of wood, sealing wax, fibrous paper, waxed twine, gutta percha and soft rubber were considered to be the normal insulating materials in the 1860's and indeed until the close of the century. Pitch-covered calico tape for finishing coils, ozokerite impregnated paper, mica, resinous oils, fibre sheet, shellac, ebonite, braided cottons, porcelain and glass had become in general use by 1900. An interesting sidelight on the various impregnants for cotton-covered wire was one named "underwriters' wire" which was a double cotton-covered type treated with zinc chloride; however, it had such an affinity for water when used under conditions of high humidity that it was speedily renamed "undertakers' wire"!

Double silk or cotton-covered wire was treated with shellac or asphaltum varnish to resist the action of moisture; wound coils were saturated in linseed oil, or dipped in natural resin varnishes, such as copal varnish. Baking varnishes were a natural development and vacuum baking was used in 1905, as well as conventional stoving methods. Oil resin varnish applied as a baked film on copper wire made



its appearance in the electrical industry, as well as varnished, bleached cotton cloth or drill.

The insulating of electrical machinery had now become a specialised section of the industry and manufacturers were able to turn to the varnish chemist for advice, and supply of their requirements. Synthetic materials were discovered that possessed advantages over the natural resin. The first impact of this was felt when Leo Hendrick Baekeland turned his attention to the process of condensing phenol and formaldehyde, resulting in the production of

the first thermosetting resins suitable for insulating varnishes, which in turn were followed by the moulded products of powder-loaded phenolics.

The position that insulation held in relation to the electrical industry was now changing rapidly: no longer was the engineer limited to the resources of his own workshop, but could leave the development of suitable varnishes and materials to manufacturers who specialised in these products.

Pinchin, Johnson & Co. were quick to realise the importance of this new field and produced their own improved types of oleoresinous impregnating varnishes, wire enamels, bonding varnishes and coatings for insulating cloth and tape. It says much for the quality of these materials that some of them have survived and are in use to this day. In general, however, the demand of the industry for more rapid production, for increased power output from smaller machines, for higher voltages and for machines which would maintain their efficiency when running at higher temperatures, has been met by the introduction of synthetically-produced substrates, impregnants and coatings.

Alkyd resins were developed from 1927 onwards and speedily found use as impregnating varnishes and as coatings for insulating cloth and sleeving. Oil-modified phenolic thermosetting impregnating varnishes, with excellent penetrating properties at high solid content, which could be cured in depth in the most complex windings, followed. The commercial production of new fibres such as nylon and terylene and the increased use of woven glass fabrics have created new problems for the resin and varnish chemist and the last 10 or 15 years has seen the industrial development of many materials which were formerly only of academic interest. Polyvinyl chloride (p.v.c.), polyurethanes, polyester, polystyrene, epoxy and polyamide are among a host of materials which have been utilised for insulation in their respective fields. The silicones and polytetrafluoroethylene (p.t.f.e.) have answered the demand for machines capable of running at very high temperatures. British Standard Specifications are in existence for vinyl acetal-, polyester- and polyurethane-covered wires and epoxy, acrylic and silicone enamels are being used in increasing quantities. Potting resins based on polyesters, or epoxy resins have been produced which enable windings to be completely encased and so prevent attack by moisture, chemical fumes and strong solvents. The phenomenal progress made by the radio and television industry has called for many specialised products from the varnish manufacturer.

Acknowledgment is due to the following for invaluable assistance in the preparation of this article:—Prof. E. Bradshaw (Manchester College of Science and Technology), Dr. E. R. Laithwaite (Manchester University), Prof. J. Grieg (King's College, University of London), Miss M. K. Weston and Mr. J. E. Smart (Science Museum, London), the Electrical Engineering Department of Manchester University, Associated Electrical Industries (Manchester), Ltd., Associated Electrical Industries (Woolwich), Ltd., Crompton Parkinson (Chelmsford), Ltd., Ferranti, Ltd., Mather & Platt, Ltd., and C. A. Parsons & Co., Ltd.

¹F. C. Williams, E. R. Laithwaite, L. F. Piggott. Proceedings I.E.E., Vol. 104A, page 102.

²F. C. Williams, E. R. Laithwaite, J. F. Eastham, L. F. Piggott. Journal of the I.E.E., Vol. 7, Jan., 1961, page 25.

AUTOMATIC ASSEMBLY

IN a lecture on the "Automatic Control of Machines for Assembling Mechanical Components" by A. V. Hemingway, B.Sc.(Eng.), M.I.E.E., and R. L. Dressler, B.Sc.(Eng.), A.M.I.E.E., it was pointed out that electronic panels and electrical equipment had been assembled automatically for some years and the methods were slowly being adopted in other industries, for example the manufacture of bicycles. Assembly machines, it was stated, could present a wide variety of control problems to the electrical engineer, and two examples were given from cycle manufacture.

The first machine assembled bicycle pedal frames at very high speed. The main difficulties were mechanical, but the electrical equipment made an important contribution by detecting faulty components and controlling the sequence of mechanical movements to keep waste time to the minimum. Reliability and long life became of first importance.

The second machine tensioned the 40 spokes in a loosely-assembled bicycle wheel. This was essentially a control problem involving 40 linked servos which together had to control the shape and position of the rim in two planes; in addition, all spokes had to be tight.

The complete system was very complex and no mathematical treatment was attempted. Instead, the problem was simplified by considering the wheel in a number of identical sections, for which a control method was developed empirically.

The lecture was given last Tuesday at a meeting of the Measurement and Control Section of the Institution of Electrical Engineers.

Letter to the Editor

Letters should bear the writers' names and addresses, not necessarily for publication. Responsibility cannot be accepted for the opinions expressed by correspondents.

Australian Equipment for the "Oriana"

WE read with interest in the 9th December issue of *Electrical Review* your description of electrical equipment fitted to the new liner s.s. *Oriana*. In this article you remark that "provision has been made for 12 ship-to-shore telephone lines when the ship is in port."

This special type of telephone outlet was designed in co-operation with the Australian Postmaster General's Department and the Port Authorities' Association for general use in all harbour installations throughout the Commonwealth. As manufacturers, we are naturally proud that our equipment has been specified in connection with this fine new vessel. We understand also that similar installations have been provided for in the P. & O. liner s.s. *Canberra*.

Electrical products bearing the trade mark "ROWCO" are well known throughout Australasia, and so we feel that this information will have interest for your readers—particularly among your overseas circulation.

Melbourne, Victoria.

J. I. SAMSON,
Advertising Manager,
H. Rowe & Co., Pty., Ltd.

Discussions at Harrogate

The 24th annual sales conference of the Electrical Development Association held at Harrogate last week was again well attended. Discussion on the five papers presented at the conference (summaries of which were published in last week's issue) ranged over a wide field

IN his welcoming address to the 400 or so Electricity Board delegates at last week's Sales Conference of the British Electrical Development Association at Harrogate Mr. David Irving (chairman, E.D.A. Council and chairman of the London Electricity Board) outlined the week's programme (chiefly relating to the domestic consumer). He said that we in this country had hardly yet begun to use electricity in the home. Average domestic consumption was rising steadily, but it was still only half that in the United States, where the annual figure at present for residential use was over 4,000 kWh.

The chairman's address was followed by an account of the Electrical Development Association's work by its director, Mr. J. I. Bernard, who gave details of this year's advertising campaign "Promoting Electricity in 1961." He then introduced members of the E.D.A., who in turn gave a short account of the work of their respective departments.

The discussion on Mr. C. Nield's paper "Presentation of Merchandise in Service Centres" was chiefly concerned with matters relating to showroom display and several speakers concerned themselves with arguments for and against the adoption of open or closed-backed windows for service centres. The first speaker, Mr. W. J. Guscott (South Western Board), strongly supported the author's views, but was surprised that he did not mention the use of competitions for building up the customer's interest.

Mr. C. H. Hardie (Eastern Board) thought there should be standardisation in the size of price cards. He was also of the opinion that architects should consult the commercial department in the early stages when designing service centres. In the past this had not been done.

A speaker from the Yorkshire Board said the fundamental principle of any form of display was interest focus and he suggested ways in which this could be achieved.

Mr. W. G. Nottage (London Board) agreed that open-backed windows presented very difficult problems and thought that where planning permitted there could be a continuation of the two alternatives. He drew attention to the position in London where there were 2,500 shops selling electrical appliances. Each competed with the service centres and Boards should look to them for display ideas. Electric lamp slot machines had been successful in this area.

Mr. Norman Phillips (E.D.A.), who

presented a paper on a similar subject eight years ago, said that the references he made then to display were not applicable today, but he agreed with the general principles of Mr. Nield's paper.

Opening the discussion on the paper "The Future for Domestic Electrical Appliances," presented by Mr. S. F. Steward (director, B.E.A.M.A.), Mr. E. H. Skinner (South Eastern Board) said he was not prepared to accept that nothing could be done to improve the size of kitchens. Space must be provided for built-in units, he said, and architects and builders should be more co-operative. He complimented manufacturers on the present-day styling, design and efficiency of domestic appliances, but feared that there had been a falling off in the standards of finish and reliability. He appealed for better inspection and packing. He spoke of the increase in the number and variety of major domestic appliances that now had to be stocked and added that the problem of servicing such a variety had not wholly been resolved. He asked that something might be done about the spare part supply position, pointing out that an appliance that might be an obsolete model to the manufacturer was with the consumer for many years.

Mr. A. S. Oldhams, speaking on behalf of the manufacturers, said the standard of service provided by the supply industry could not be better than the practical support given to it by the manufacturers. He gave later comparative gas and electric cooker production figures than those quoted in Mr. Steward's paper. In November last 52,500 gas cookers were produced, compared with 51,379 electric cookers and the ratio was thus reduced to 1.02 to 1. The

The conference chairman, Mr. David Irving, speaking at the opening session. Seated, left to right: Messrs. Norman Phillips, J. A. Stedman, J. I. Bernard, E. M. Ackery and Philip Honey (all E.D.A.)



production of cookers with timers had increased in the past 15 months. In the same period two-plate cooker production had been fairly steady at 3 per cent, but the number of three-plate models had dropped from 93 to 65 per cent. Four-plate models had shown a significant rise from 4.4 per cent to 31 per cent.

Mr. L. Shepherd (Eastern Board) spoke of the advantages of electric water heaters and immersion heaters and stressed the fact that they should be left on continuously under thermostatic control.

Another representative from the manufacturing side, Mr. E. G. Plucknett, said that manufacturers of electric cookers took the subject of quality and inspection very seriously. He explained the reason for "teething troubles" on first production models, drawing attention to the multiplicity of components that went into a cooker.

Mr. M. W. Hime (South Eastern Board) would have liked to have seen some reference to air conditioning plant in Mr. Steward's paper. He thought the electrical industry had not done enough in this field and suggested that the two sides should get together on this subject.

Mr. A. O. Johnson (North Western Board) said that the total amount spent on advertising and Press publicity by the Boards and the E.D.A. in 1959-60 was £1,600,000, while the gas industry spent £2,070,000.

Mr. H. D. W. Allen (London Board) spoke of the problems of Boards' servicing departments and suggested the provision of maintenance manuals for electric cookers.

Mr. R. W. Evans (South of Scotland Board) was another speaker who deplored the smallness of kitchens. He admired the ingenuity of manufacturers who designed built-in equipment. Many of the appliances being sold today were too small—simply because of the size of kitchens.

Mr. H. C. Timewell was another manufacturer who answered criticisms directed against cooker manufacturers. He said that if any progress was to be made at all in the design of appliances a certain amount of experimentation must be accepted.

It was the opinion of Mr. D. MacDougall (South of Scotland Board) that there were too many cooker manufacturers. In his district (Glasgow) they could conveniently stock and maintain only five different manufacturers' models.

The author, in a brief reply, accepted that improvement and reliability were key sales points, without which much of what he had said would be defeated. Regarding reliability, particularly of new products, maybe there was more that could be done with the joint testing of prototypes and the early provision of information to service centres before the models were on the market. The question of spare parts was a joint responsibility that both the Boards and the manufacturers had to share.

The discussion on the paper entitled "More Adequate Wiring," by Mr. W. F. Jarvis, was opened by Mr. R. B. Richardson (Eastern Board), who said that possibly the most important question asked by the author was "How



Personalities at the E.D.A. Sales Conference, left to right: Mr. G. N. Green (chairman, North Eastern Board), Mr. J. I. Bernard (director, E.D.A.), Sir Robertson King (chairman, Electricity Council), Mr. S. Broughton (managing director, Electrolux, Ltd.) and Mr. David Irving (chairman, E.D.A. Council, and chairman, London Board)

long will the 60 A main service fuse and cut-out remain adequate?" The answer, he said, would be in what the ultimate load would amount to in an average domestic installation. He said the maximum energy requirement for a small domestic establishment was something in the region of 25 kW.

He was not certain of the need for a new 30 A fused plug circuit nor could he visualise any appliances that would require such an installation. The time-controlled distribution unit, referred to by the author, he described as a glimpse into the future and thought its greatest use would be in the control of off-peak loads.

Mr. M. R. Cowan (North Western Board) said part of the paper was a re-examination of the Boards' own contracting policies or methods. He said if the Boards had a lively and highly competitive contracting section in every district a great start could be made towards getting more adequate wiring.

Mr. R. P. Coombes (Southern Board) saw no reason for having cooker circuits above 30 A, but thought they might incorporate miniature circuit-breakers. Domestic appliances, he said, should not be rated above 3 kW.

Mr. K. G. Harris (Eastern Board) said that a lot had been heard about the need for more adequate wiring, but he thought that attention should be paid to the need for more adequate fusing.

Mr. R. S. Goddard (North of Scotland Hydro-Electric Board) said that builders would not allow much more than 1 to 1½ per cent of the total cost of a building for electrical work and supported Mr. Jarvis in his claim that £35 did not give an adequate wiring installation. He said that gas competition must be watched.

Mr. L. R. Daniel (South Western Board) said that since introducing hire-purchase facilities to pay for wiring in his Area there had been an increase in the sale of domestic appliances.

In his reply Mr. Jarvis said it was not a question of bringing more pressure to bear on local authorities, but it was the responsibility of district commercial engineers and their staffs to keep in close touch with them. He was quite sure that this would show results in the end.

As might have been expected, the discussion on Mr. A. F. Hardcastle's paper "The Control of Off-Peak Floor

"Warming in Domestic Premises" was mainly concerned with the debatable question of landlord or tenant control and many arguments were heard both for and against.

Mr. H. J. Gibson (Midlands Board), opening the discussion, said that it was quite evident that floor warming had seized the imagination. He agreed that there must be some heat loss to adjoining flats, but in practice such heat losses were only small. Landlords' responsibility, he continued, might be the answer to the education of flat tenants to accept this form of heating.

Mr. R. S. Goddard (North of Scotland Hydro-Electric Board) stressed the importance of keeping capital costs down. There were, he said, several schemes in operation in Dundee and added that time switch control was the most flexible arrangement.

Mr. L. Shepherd (Eastern Board) said one should not ignore the fact that with any system of heating some interchange of heat would take place between adjacent premises. He would encourage the maintenance of background temperatures in local authority flats at around 55°F, to be "topped up" when required by radiant heaters. Such heaters, provided as part of the heating installation, need have a loading of only half that which might be needed if floor warming were not installed, with consequent easing of load demand.

Mr. G. D. Pilkington (Southern Board) said that his experience of landlords' control suggested that so far this was the right method.

Mr. J. W. Moule (South of Scotland Board) said that there were 400 blocks of flats in his Area under tenant control. He asserted that to go so far as to advocate landlord control of floor warming installations would introduce the danger of throwing away one of the main planks that the extraordinary growth of this off-peak form of heating was based upon. In his experience tenants did not switch off but used it in the manner intended and he made a plea for an open mind to be kept on the question of landlord-versus-tenant control. He was supported by other South of Scotland Board speakers, one of whom said that by adopting landlord control there was a danger of losing direct liaison with the consumer.

A member of the Southern Board was, however, fully in favour of landlord control. In his area, he said, there were 3,000 installations under landlord control compared with only 160 controlled by the tenants.

The author, in reply, said that he had anticipated a lively discussion and had got it. Apart from the question of landlord-versus-tenant control, however (opinion on which appeared to be evenly balanced), there were few points on which he had to comment. The one general observation of the chairman, Mr. D. H. Kendon (chairman, M.A.N.W.E.B.) was that there had been widely differing views and he thought there was nothing to be gained by forcing a decision.

Mr. A. Ellison (North Eastern Board), having presented a paper entitled "The Board and the Small Consumer," the discussion was opened by Mr. W. B. Parkinson (Merseyside and North Wales Board), who said that the potential for development offered by the small industrial consumer need not be spectacular in order to be worth while. He listed the matters in which district staffs should have a reputation for expert knowledge—provision and maintenance of supply; tariffs, with particular reference to interpretation; contracting; lighting designed for small

installations; space heating; water heating; and electro-heating for industrial purposes.

Mr. H. D. W. Allen (London Board) said that London was not noted for large industrial consumers, but had plenty of the type referred to by the author, whereas Mr. A. Moug (North Western Board) said that his experience was that there were a number of small industrial consumers with inadequate electrical equipment, who were content to "jog along" so long as they made a profit.

Mr. J. R. Cameron (North Eastern Board) felt that the period of training for industrial development engineers, suggested by Mr. Ellison (two weeks), was not enough. He thought that the Electricity Council should organise suitable courses at the establishments already in being. In this he was supported by Mr. E. H. Jordan (North Eastern Board). Mr. Jordan also added that apart from the new industrial consumer there was the problem of the existing industrial consumer. With regard to the latter, he said, there was very real scope for development. Many industrialists were troubled with heating problems—heat loss and heat gains—and he suggested that Boards should undertake research into the matter.

Mr. R. J. Wills (South of Scotland Board) questioned how far the Boards went to discover if a change of tariff would be beneficial to the consumer. In his area there was in force a system whereby if after a year a tariff was found to be unsatisfactory a retrospective adjustment was made.

In the Southampton area there were about 450 small industrial consumers, said Mr. R. P. Coombes (Southern Board); he thought it unnecessary to ask for a contribution wherever the industrial load was to be increased.

As a speaker from the Yorkshire Board saw the problem the battle in lighting was over years ago but he was not convinced that lighting had been exploited to its ultimate limit. The battle for power, he said, had been largely won but there still was not sufficient power used for tools, mechanical handling, etc. The great problem was in the battle for heating and it was in that direction that the main development lay.

In reply Mr. Ellison said that the training of specialists was not practicable in every Area. He did not want to teach the industrialist his job. A two weeks' course, he agreed, was too short but it was only intended to be a preliminary for further training.

Closing Session

Mr. David Irving presided at the closing session at which the greater part of the time was devoted to a general discussion. The closing address was given by Sir Robertson King, chairman of the Electricity Council, who said there was a tendency to concentrate sales efforts on domestic consumers and sales of appliances and to forget that nearly 50 per cent of the Board's business concerned the industrial user. The sales to power users, he said, had increased by 165 per cent between 1948 and 1960. There was still something like 3,500 to 4,000 MW of industrial load supplied by private generation. He concluded by reminding those present that the rise in sales of domestic appliances must not lull the Boards into a sense of complacency in the face of their competitors.

The conference concluded with a luncheon and thanks were expressed by the chairman to Sir Robertson for his address.



Orrin dam, Connon Valley scheme, Ross-shire

HIGHLAND ELECTRICITY

DURING the year ended 31st December, 1960, the operations of the North of Scotland Hydro-Electric Board produced a credit balance of £222,595. The total hydro-electric capacity was increased by 8.54 MW to 875 MW, while 572 MW of plant was under construction and a further 555 MW of potential capacity was under survey. A further 8,690 new consumers were connected during the year. These figures are given in the Board's annual report and accounts for 1960 (H.M. Stationery Office, price 5s), published last week.

Although 1960 proved to be exceptionally wet in most parts of the British Isles, this did not apply to the Board's catchment areas where there were marked deficiencies in rainfall. The flows available for power were much below expectations, being only 81 per cent of average, and thermal generation had to be used to help to maintain the reservoirs at levels high enough to meet the heavy winter loads. If the rainfall had approximated more nearly to that in the rest of the country the accumulated deficiency might have been completely wiped out.

No tariff changes took place in 1960, but the increase of 14 per cent in ordinary consumer revenue included a full year's income from the tariff increase of 5 per cent which became effective on 1st July, 1959.

In common with other nationalised bodies, the Board since August has been paying $6\frac{1}{4}$ per cent on advances from the Exchequer, this rate having been raised seven times since the beginning of the year when it stood at $5\frac{1}{8}$ per cent. The continuing high interest rates are of particular concern to the Board as interest charges absorb more than half its revenue, even after taking advantage of the statutory provision whereby, within limits, the Board may borrow to meet interest on expenditure on long-dated projects while that expenditure is unremunerative.

The weather in 1960 was generally favourable for the Board's constructional operations which were centred mainly on the Beauly, its tributary the Farrar, and on the

River Awe. In October, the constructional scheme for the Nevis project was published. It is designed to meet the growing demands for electricity in the Board's area. A start was made with the preparation of a constructional scheme to raise the level of Loch Laidon and provide greater regulation and more effective use in the Tummel Valley stations of the water coming from the Moor of Rannoch.

Power stations generated 2,435 million kWh of which 2,096 million kWh was produced by hydro stations, the maximum demand being 535 MW. The average cost of all hydro, steam and diesel energy generated or purchased was 0.8374d/kWh sent out.

Last year, 1,602 million kWh was sold to the Board's consumers, an increase of 13 per cent over 1959. Sales to the South of Scotland Electricity Board totalled 565 million kWh and purchases of off-peak energy from them amounted to 96 million kWh.

Construction

During 1960 the weather was generally favourable for outside work. There were long spells when rivers were at exceptionally low levels. No severe snowstorms occurred to interfere with access. In Glen Strathfarrar all working sites were opened up. Steady progress was made on the various tunnel works, but poor rock conditions caused some delay in the excavation of the underground power stations at Deanie and Culligran. At Aigas and Kilmorack, work is behind programme and these stations will not be commissioned as soon as had been hoped.

On the Awe scheme, work on the Inverawe power station and barrage are making good progress, but special measures will be needed if the construction of the tunnel is to keep in step. Work has also started on the Nant contracts and on the access tunnel to the Cruachan underground power station. Completion in July of Cassley power station brought to an end all the work which had been contracted

for in the Shin scheme. In the Tummel Valley, work on the 2,200 kW development at the outlet of the tunnel from Loch Garry to Loch Ericht is well advanced and alterations were completed on the Tummel Bridge aqueduct. At Loch Glashan good progress has been made on almost all sections, but particularly on the major diversion aqueducts and power station. Similarly, in Glen Moriston progress on the Doe aqueducts and on the Livishie project was satisfactory.

The Gisla (Lewis) scheme was completed and the power station was put into operation in August. At Chliostair (Harris) work was sufficiently advanced to enable the power station to commence operation in mid-December although full impounding was not possible. At Mucomir, the construction is now approaching the final stages.

Approximately 10 miles of tunnels, mostly on the Strathfarrar works, was driven during the year, making the total 169 miles. A further 18½ miles is being driven.

The rock-fill dam at Lochan Breacalich, in the St. Fillans section of the Breadalbane scheme, was completed during the year. It required some 275,000 cu yd of stone and is of similar design to that at Quoich.

Clunie and Pitlochry dams were given the statutory ten-yearly inspection required under the Reservoirs (Safety Provisions) Act, 1930, and the reports were satisfactory. In view of the Frejus disaster in France, the Board arranged for special inspections of all their major dams and received very favourable reports from the inspecting engineers.

The power stations at Gisla and Chliostair were commissioned during the year and will add 1,540 kW to the generating capacity in the Islands of Lewis and Harris. The Lednock station of the Breacalich section of the

Work in progress on foundations of Inverawe power station



FINANCIAL RESULTS

	During Year	At 31st Dec., 1960
<i>Capital Expenditure</i>	£	£
Hydro-electric schemes	6,594,164	147,970,594
Steam and diesel power stations	544	5,534,082
Transmission lines	962,885	17,567,582
Distribution	2,554,195	42,619,396
Sundry	105,965	1,823,929
TOTAL	10,217,753	215,515,583
	1959	1960
<i>Revenue</i>	£	£
Sales of electricity		
(a) Ordinary consumers	10,285,229	11,762,412
(b) South of Scotland Electricity Board	3,578,428	3,700,978
Trading surplus		
(a) Electricity	6,915,902	8,122,309
(b) Work done and sale of goods	125,538	19,010
TOTAL	7,041,440	8,141,319
Less interest and other charges	7,070,610	7,918,723
Net surplus or deficiency	— 29,170	+ 222,596
Accumulated deficiency	753,626	531,030

Breadalbane scheme was also completed and is due for commissioning early in 1961. Among the power stations on which work is proceeding, those at Livishie, Deanie and Culligan are to be underground and at Inverawe, Kilmorack and Aigas the stations are to be above ground and built in natural stone.

Running of the Altnabreac experimental gas turbine peat plant continued until mid-June. Peat combustion proved difficult to control and it became evident that substantial modification and expenditure would be necessary to effect improvements. Pending a decision from the Development Commissioners as to whether they would continue to make grants available in aid of the experiment, the plant was put on a care-and-maintenance basis.

During the year the plant was run for 1,201 hours. It produced 665,400 kWh and burned 1,398 tons of peat. The total number of hours which the plant has run since it was first started in June, 1958, is 2,657.

Transmission

During the year, the length of 132 kV lines in commission increased by 101 to 1,896 circuit miles. At the end of the year, a further 45 circuit miles was in course of construction.

Progress was made with the contracts for the 275 kV lines between Beaulay and Kintore and between Kintore and Tealing. The first 12-mile section between Tealing and Lunanhead was energised initially at 132 kV to give supply from Tealing to Lunanhead. Negotiations proceeded for wayleaves required for the 275 kV line which will connect the Loch Awe pumped storage scheme to Windyhill substation. New 132 kV substations were commissioned at Tealing, Glenagnes and Lunanhead.

The communication, indication and metering facilities at the central system control room at Port-na-Craig have been modified and improved to suit network and technical changes. The power stations at Cashlie and Lubreoch were converted to full supervisory remote control from Lochay. The necessary apparatus was installed at Lednock power station to enable remote control to be exercised from St. Fillans power station.

All-electric Dwellings

The marked preference for all-electric housing continued. During the year the first of several blocks of

multi-storey all-electric flats in Perth and Dundee were connected and Dundee Corporation decided to proceed with 500 all-electric flats, the first stage of their new Menzieshill housing development. In Thurso, further all-electric houses are being built by the United Kingdom Atomic Energy Authority and for the Town Council by the Scottish Special Housing Association.

During the year, a further 26 new all-electric grain dryers were installed on farms and several existing all-electric grain-drying installations were extended.

As a result of advice given by the Board and because of the facilities available in the Board's District, Radiation, Ltd., decided during the year to rent a factory in Peterhead where they will manufacture cookers and water heaters.

Research

As a possible means of combating the effects of cavitation on turbine runners, erosion-resistant coatings of synthetic rubber have been applied to a runner where trouble can be anticipated and inspections will be made from time to time to assess the value of the treatment.

As a result of thermal rating tests carried out on the alternators at Fasnakyle, the sets, when dewatered and

running as synchronous reactors, can now provide a greater amount of line-charging current. To get these results, negative field excitation is applied.

Work has continued in conjunction with Ferranti, Ltd., Edinburgh, on the development of their fault locator which operates by injecting pulses into the live 132 kV line via the existing coupling equipment. A complete prototype equipment was installed in January, 1960, at Fort Augustus and operated for several months under normal working conditions. Several transient faults were located and ice detected on conductors in the Corrieyairack Pass. Conductor swinging due to sudden shedding of ice was also observed. The information obtained was found useful to System Control as it indicated when switch reclosure was likely to be successful.

As planned, the work on wind loads arranged in conjunction with the Electrical Research Association on the overhead line test span erected across high ground on the route of the 275 kV line between the Awe pumped storage scheme and Windyhill continued throughout the 1959-60 winter period. The winter was milder than anticipated, but valuable information was obtained about the nature of the winds in that area.

Applications of Coding Theory

By J. M. MEGGITT, M.A., Ph.D.

Author's summary of a lecture entitled "Coding Theory and its Applications" which was delivered at a meeting of the Electronics and Communications Section of the Institution of Electrical Engineers on 22nd February

IT is becoming increasingly necessary to transmit data accurately over long distances at high speed. Obvious examples are air traffic control and airline ticket reservation systems. The requirements mentioned above arise in any of the tele-processing applications that are so frequently discussed by computer engineers. Basically, the greatest economy is obtained by sharing one large central computer and to operate it remotely.

The telephone network provides a world-wide communications system, and it is obviously an attractive proposition to use it for this new purpose. Unfortunately, telephone systems were designed for the transmission of speech, and speech is intelligible in the presence of all sorts of noise. This means that the existing lines are rather poor for the transmission of data and indicates an important distinction between speech and data. Data arises in the form of sequences of zeros and ones, coming, perhaps, from punched cards or the closing of switch contacts or from magnetic tapes. These are sent over the telephone lines as pulse chains, usually frequency or phase modulated. It is normal for every pulse in this chain to be important, so that if noise introduces an error then the wrong message

is received. This does not happen with speech. Words are often very different from each other in sound, so that even if a word gets distorted it is still clear which word it is.

The foregoing suggests the general idea of a block code for the transmission of data. The message is split up into blocks of pulses, and to each block is added some more pulses that depend on the information pulses. This block of information is now said to be coded and it corresponds exactly to the word that arises in speech. Obviously not all received messages are valid, in the same way as not all received words are meaningful. However, it will probably happen that the received message is more like the correct message than any other, so it is possible to decide at the receiver just what the correct message is. It must be realised, however, that no coding system is completely fool-proof. In speech one word can be turned into another by noise and the hearer will make the wrong interpretation. The same thing can occur with a coding system. Among other things, this suggests a block error correcting code. If in speech the word received is so distorted that it resembles nothing, then the hearer is at liberty to ask what was said and the word may then be repeated. In this case

the hearer has detected an error, but has been unable to correct it. In the same way, with coded data transmission, it is possible if the received message is not valid and completely unlike any valid message, to indicate an error without being able to correct it. This illustrates the idea of a block code that corrects minor errors and simultaneously detects major errors.

To continue the argument, speech consists not of isolated words but of sentences. Thus, even if a single word is wrongly interpreted, there is sufficient redundancy in the sentence to allow an intelligent guess to be made at what the sentence really should be.

Thus we come to two-level block coding. Small blocks are coded as previously described, and then these are treated as symbols in a larger message. The large message is thus coded by taking a big block of these small blocks and adding some more redundant small blocks. At the receiver the small blocks are corrected as they are received, and then afterwards the large block is corrected, so that even if one or two of the small blocks are corrected wrongly, the entire message is corrected properly.

Choice of System

These are the kinds of possibilities that coding offers. The optimum scheme seems to be a multi-level one. For the present, however, it is interesting to discuss the merits of single-level detecting and correcting codes. A code that is entirely error-correcting suffers from the defect that a major error may cause the message to look more like some other valid message so that the attempted correction not only leaves behind the errors but introduces some new ones by the false correction process. On the other hand, if a detection system is used, then a return transmission channel must exist along which a command for a repetition may be made. Time will be lost in this repetition, and simplicity will be lost, because the receiver will have to wait before it gets back into synchronism with the transmitter.

It looks as though the best system depends on the nature of the errors that occur. If minor errors occur frequently, together with rare major ones, then a combined correcting and detecting code seems a good one. If the only errors that occur are major ones, then a detecting code is required.

In a practical system the coding and decoding equipment must be as elementary as is possible otherwise it will be too expensive. Where the line feeds a computer or data processing machine then the computer itself may be employed to do the decoding, but even then simplicity is still a great advantage.

One requirement that cannot be avoided is for some storage of information in the decoder. Until all of a message block has arrived it is not clear whether the message is valid or not, so correction cannot take place until all the message has arrived. Hence, the decoder must at least have capacity to store the received message.

The first requirement of a practical code is that, apart from the necessity of providing some storage capacity in the decoder, the equipment should be cheap and simple. It must also detect and correct errors. Any code will correct or detect certain errors in the message, and the number of these depends on the amount of redundancy that is added to the message. In a practical code the redundancy should be as low as possible and yet all errors that arise should be detected or corrected. This is analogous to deciding what modulation system it is best to use in the

presence of a known sort of noise and, of course, a system that combats one sort of noise will probably not be effective in the presence of another sort.

There are many opinions regarding the sort of noise that arises in telephone networks. This is not surprising because noise is introduced by many causes and, if each cause produces its own distinctive error pattern, then the complete error pattern will be obscure and depend on the number of exchanges the signal passes through, the quality of soldered joints, the activity of maintenance engineers and so on.

There is some evidence that bursts of errors occur. This does not mean a string of successive errors, but a group of digits limited to a certain length within which errors occur. A simple set of codes has been devised which can efficiently correct such bursts of errors. The same codes and equipment may also be used for detecting pairs of such bursts as well as for detecting many other error configurations. The theory, unfortunately, does not extend far enough for general rules to be given about exactly what these additional error patterns are, but, of course, calculations may be made for specific examples. The same codes and equipment may also be employed in a third mode where short bursts are corrected and the rest of the redundancy is used for detection.

There is also a set of double error correcting codes that lie within the same framework, and which may again be used in correcting or detecting modes. The theory of the codes is fairly complicated but, to generalise, the encoders and decoders consist of linear fed back-shift registers. The fundamental idea is that if the message is correctly coded, it is such that if the register is initially empty and the message is fed along the channel labelled "input," then when all the message has been received, the register is again empty. In the decoder, this property is exploited by examining the contents of the shift register when the message has been received. What it contains, if other than zero, is an indication of the nature and position of an error. The encoder is so constructed that the condition is forced upon the message as it is encoded and this is what determines the check digits.

Within this system, the principal freedom one has is in choosing the length of the basic shift register and in making the feed-back connections. As these are varied so the whole set of codes whose properties are indicated is produced.

The general ideas presented here have formed the basis of nearly all coding work. However, many previous codes have been too complicated to implement. In contrast, the shift register codes are attractive because of their simplicity. It is of great interest that nearly all previous codes may be transformed into shift register codes. In this form they are functionally equivalent to what they were before, but the equipment is very much smaller.

A.E.M.T. CONVENTION

THE Spring Convention of the Association of Electrical Machinery Trades is to be held this year at the Queen's Hotel, Eastbourne, from Saturday, 29th April, to Tuesday, 2nd May. A paper on recent developments in automatic control in industry using electronic techniques is being given on the Monday morning by Mr. R. J. F. Howard, of Lancashire Dynamo Electronic Products. This company and Hirst Electronic are holding an exhibition later in the day.

FULLY TESTED

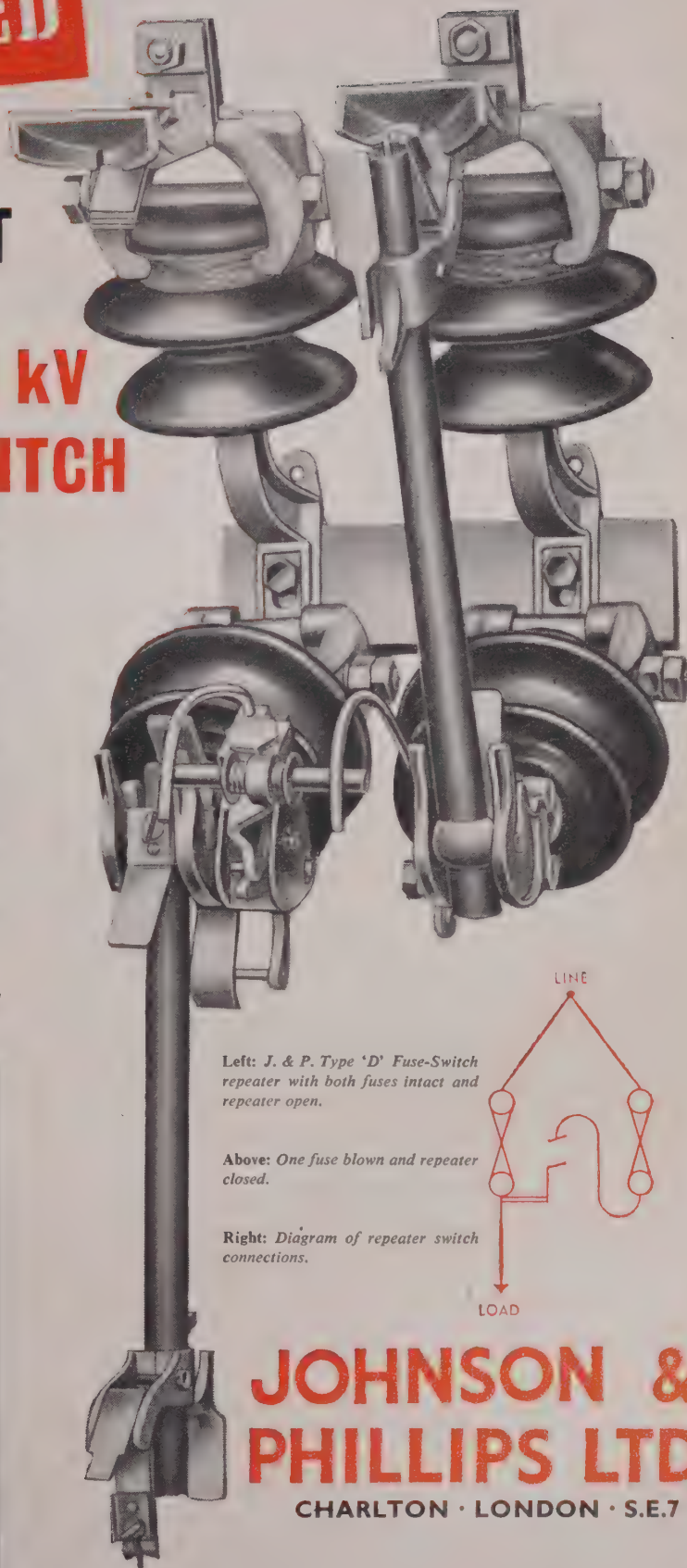
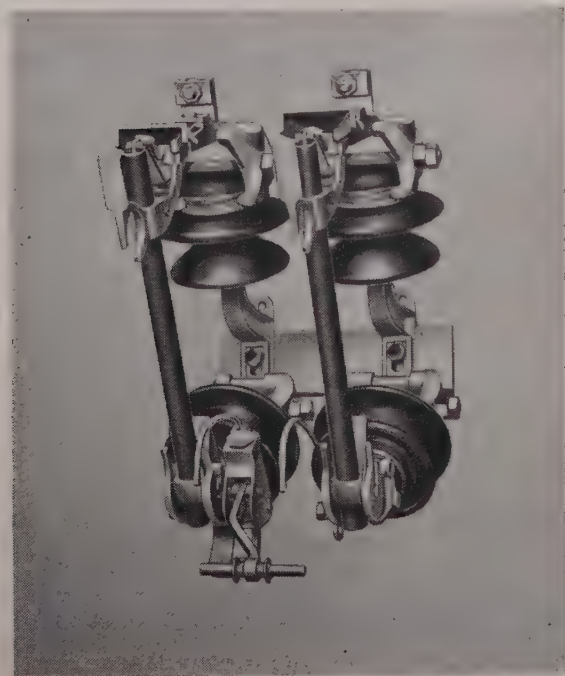
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Left: J. & P. Type 'D' Fuse-Switch repeater with both fuses intact and repeater open.

Above: One fuse blown and repeater closed.

Right: Diagram of repeater switch connections.

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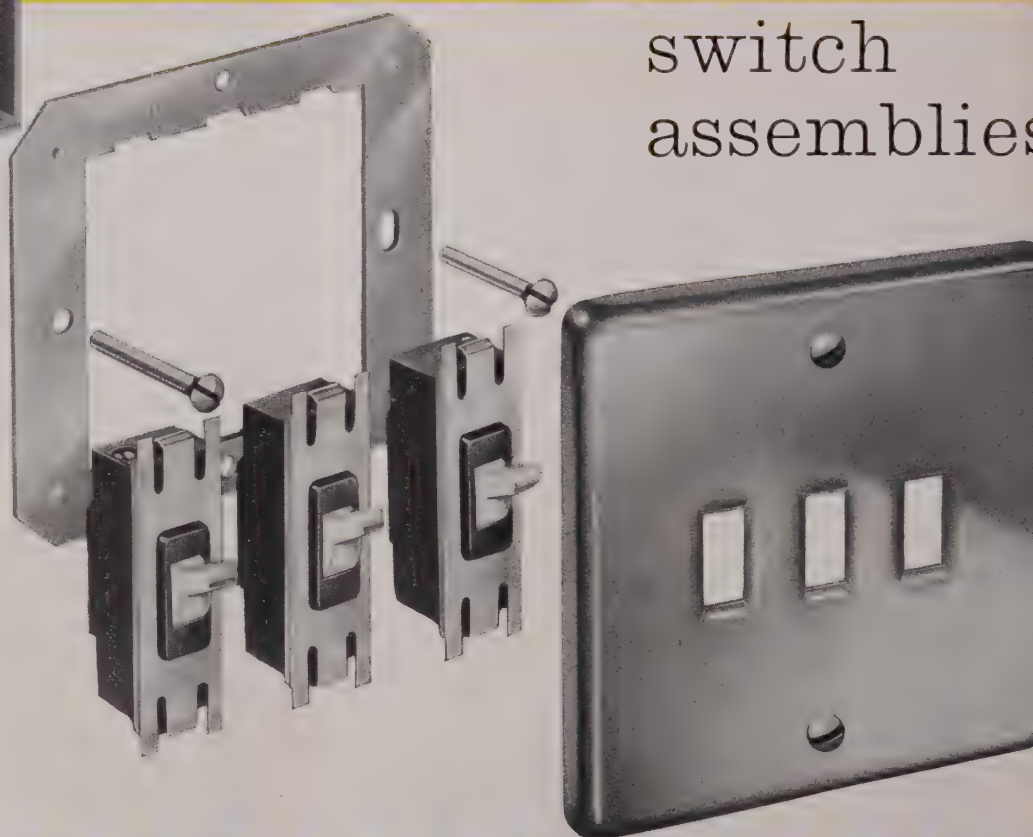
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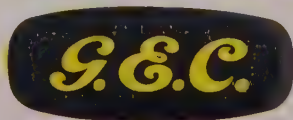
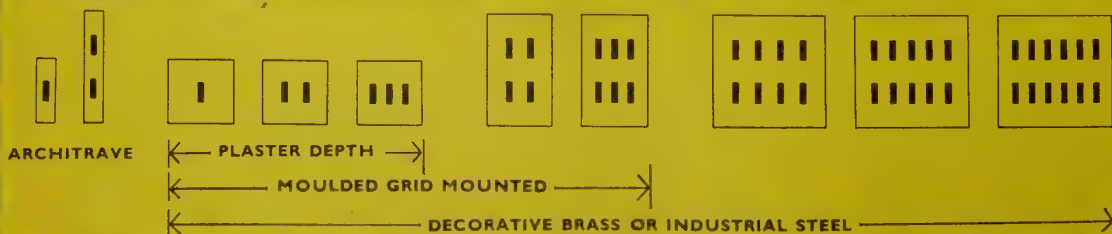
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INVERTERS

GRID-CONTROLLED MERCURY ARC RECTIFIERS
with or without arc suppression

S.E.C.

OF ENGLAND

THE GENERAL ELECTRIC COMPANY LIMITED OF ENGLAND, RECTIFIER AND ELECTRONICS DIVISION, BIRMINGHAM, 6.

Power for the Press

Electrical Services in the New "Daily Mirror" Building



THE new *Daily Mirror* building at Holborn Circus, London, is now complete. This 18-floor building combines the most up-to-date newspaper buildings in the world with extensive modern office facilities. There are four basement levels which accommodate the printing works and above these there are four floors which cover most of the site area and form a platform for the tower floors which reach a total height of 169ft above street level. The electrical requirements of the new building are among the largest called for in any one building in the city of London.

A three-phase 11 kV supply is provided by the London Electricity Board to cater for a maximum demand of 7,500 kW, which has been created by the extensive machinery and plant installations as well as the normal lighting and power services associated with a building of this size. For example, the five press lines of the ultimate installation are driven by 7,250 h.p. of electric motors and the six metal casting machines in the foundry, using immersion heaters, demand 1,320 kW. For the main heating and air conditioning systems 1,500 h.p. is required, the lift installation demands over 700 h.p. and there is provision for the compressors to reach a total of 800 h.p.

Coupled with the above demands are the power requirements for the paper reel handling mechanisms, printed paper conveyors, stereo plate conveyors, canteen kitchen equipment, telephones, and the general lighting and power services throughout the building.

The power is taken into the building at two points, at the north-west and the south-west corners at first basement level. The two L.E.B. substations accommodate identical equipment. Each switch-room contains a five-panel Reyrolle type LC 23T switchboard, on which two oil circuit-breakers, embodying Solkor protection, control the two 0.25 sq in, three-core, 11 kV incoming cables; two oil circuit-breakers, fitted with overload and earth leakage protection, control two outgoing 0.25 sq in cables to the switchboards under *Daily Mirror* control and one bus-section switch, with one incoming and one outgoing oil circuit-breaker placed on each side.

From the L.E.B. substations the power is fed into one ten-panel and one nine-panel Reyrolle type LC 23T, 11 kV switchboard; each board is electrically sectionalised and under the control of the *Daily Mirror*. It is possible to take power from either or both feeders as desired. The switchgear is of the metalclad compound-filled type, with vertically isolated oil-break circuit-breakers having a rupturing capacity of 150 MVA at 11 kV in accordance with B.S. 116.

Incoming supplies to the *Daily Mirror* boards are controlled by isolatable, non-automatic oil-break switches; these are Castell-key interlocked with their associated busbar-section circuit-breaker, thus ensuring that paralleling of the two supplies is impossible. A spare h.v. transformer isolator chain, available at each intake, provides standby facilities in the event of any major breakdown, an essential feature in a newspaper publishing business.

The nine-panel and ten-panel boards control between them twelve 1,000 kVA, 11 kV/415 V power transformers. In these transformers, no insulating oil is employed and they are natural air cooled. The advantages gained are a 40 per cent reduction in weight and being fireproof, having high overload capacity and low iron losses, there is no need to widely space or specially segregate the units from the equipment they supply. Thus there is a saving in floor area, a greater flexibility in layout and lengths of heavy connections are minimised.

The low-voltage supply is fed into an isolator and then distributed either to air-break circuit-breakers for the press lines or high rupturing capacity switch-fuses for general distribution throughout the building. A total of ten main switchboards control the power to the printing press lines and ancillary services, including ventilation and air conditioning. All basement floors and the first three floors are mechanically ventilated.

There are twenty motors to each press line. Each motor set consists of a 72½ h.p. main motor, a two-speed barring motor, a ventilating fan motor with filter, and a brush-setting motor for speed control. The press drives are of the series type, variable-speed a.c. commutator class, the

drooping speed characteristics of which are suitable in such an arrangement where several motors drive a common shaft.

Low-Voltage Distribution

The low-voltage distribution system consists of single-core, cambric-insulated, lead-covered cables carried on trays from the twelve 1,000 kVA air-cooled transformers to the l.v. switchboards. Distribution from the switchboards to the passenger and goods lifts is by means of cambric-insulated multi-core, corrugated aluminium sheathed cables. A copper bar rising main distribution system is installed in each of the main north and south service ducts rising from the first to the eleventh floor. This carries power via tap-off distribution fuse units to the lighting and plug-socket services on each floor; selector links ensure a balanced load between floors.

The height of the building necessitates very long vertical cable runs. Helix aluminium-sheathed cables with copper conductors and cambric insulation were specified; these give a considerable weight reduction, ease of handling and greater horizontal rigidity. The cables are sheathed overall with p.v.c. to prevent corrosion of the aluminium.

Parallel cables are run in most cases to give a smaller turning radius and ensure continuity of supply in the event of a fault.

On the editorial and general office floors, a three-compartment Key fibre duct system on a 15ft by 7ft 6in module, and fitted with outlets at 5ft 6in centres throughout the grid, has been installed in each floor to carry 240 V supplies, TV aerial feeders and telephone wiring. A three-compartment steel skirting duct, fitted to the perimeter walls of these eight upper floors and interconnected with the floor ducting, has been installed. Cover plates have been fitted to the skirting duct, allowing small power, low-voltage and telephone outlets to be arranged in any desired position according to the layout requirements of the offices. The power wiring to the main heating and ventilating system consists generally of Pyrotenax cable.

Multicore control and monitoring wiring has been used in the installation of the building services control room on the eleventh floor. This room contains over 300 indicating lamps, 150 control points and 96 pushbuttons and gives instrument readings from 120 points in the building. The equipment provides overall monitoring, showing plant running, overload fault, plant off and isolator off for the fully automatic mechanical ventilating installation. The control panels have pushbuttons for remote control of over 200 motors, totalling 1,400 h.p. and varying from 75 h.p. Schrage machines to fractional h.p. valve controls.

Most of the illumination in the building is provided by fluorescent tubes, and this involved the wiring and installing of some 6,000 lighting points. The majority of office ceilings are of flush acoustic tiles and "intertrunking" of two-compartment ducts has been incorporated to house all wiring and lighting fittings. This method ensures ease of maintenance and means of varying the lighting arrangements. The control switches are of the ironclad protected, adjustable grid flush assembly type and flush shock-proof switch assemblies are provided with nylon insulation.

The fluorescent lighting fittings have been supplied in 2ft, 4ft, 5ft and 8ft lengths and most have instant-start gear. In all, nearly three miles of lighting fittings have been installed throughout the building.

Special lighting installations include the illuminated ceiling fittings in the ground floor main entrance and the lift foyers and the special angle fittings providing light on the press lines. Emergency tungsten lighting, fed by nickel ferrous batteries, is provided for use in case of power failure.

Two Synchronome master clocks, controlling 346 slaves, have been installed; they are capable of time keeping to within ± 2 sec a week. The master clocks also control 80 fire patrol key boxes and these are wired back to a central fireman's recording clock. Call lamps are installed at certain of the key boxes so that a fireman on patrol can be made aware that he is required. A further refinement is the installation of an indicator board whereby the progress of a fireman's patrol is visually indicated.

There are six high-speed passenger lifts in two groups of three, one in the south, the other in the north of the building. There is an additional lift for use by senior executives in the north group. The six main lifts have a capacity of 3,500 lb, travel at 700ft/min and are driven by 54 h.p. gearless machines. Control is by the unit multi-voltage system from independent d.c. generators. The controllers operate on the group collective traffic timed scheduling system. The six goods lifts are heavy duty machines driven by 55 h.p. d.c. motors through single worm reduction gears and are controlled in a similar manner to the passenger lifts. Collective operation is incorporated in all the controllers of the goods lifts so that landing calls are answered in rotation, provided the cars are not fully loaded; in this event landing calls are by-passed until such time as the cars have been unloaded.

Three paper reel "Lowerators" have been installed to deliver paper reels from the ground floor to the second and fourth basements. Basically, the "Lowerator" consists of a motor-driven endless chain carrying a series of reel cradles. Electrical interlocking is provided and includes the control of the fireproof roller shutter motors and a complete system of light indicators is incorporated by which the various floor levels can signal their requirements.

Master switches for all electrical circuits are housed in special lock-up wall boxes adjacent to the basement discharge exits. Power is provided by 30 h.p. slip-ring motors driving through flexible brake drum type couplings to 50/1 reduction gears, giving an output speed of 19r.p.m.

Communications

A cordless automatic internal telephone system with 98 exchange lines, 13 private lines and 800 extensions has been installed by Standard Telephones & Cables, Ltd. Provision has been made for these figures ultimately to increase to 250 exchange lines, 54 private lines and 1,800 extensions. This is the first major installation of its type to be completed in this country.

The electrical installation work was undertaken by Rashleigh Phipps & Co., Ltd. Other suppliers included:— Lighting fixtures and fittings, General Electric Co., Ltd., Atlas Lighting, Ltd., Troughton & Young (Lighting), Ltd., Falk Stadelmann & Co., Ltd., and Farmer Stedall & Co., Ltd.; transformers, Hackbridge & Hewitt Electric Co., Ltd.; main switchgear, compressor motors and control equipment, A. Reyrolle & Co., Ltd.; low-voltage switchgear, Associated Electrical Industries (Rugby), Ltd.; emergency lighting equipment, Alkaline Batteries, Ltd.; and cables, British Insulated Callender's Cables, Ltd.

VIEWS on the NEWS

By "REFLECTOR"

WHEN trams and trolley-buses are taken off the roads the overhead gear has to be disposed of. Occasionally the local authorities in whose districts the vehicles ran seek to economise by using the poles and across-the-road wires for mounting lighting units. Referring to such proposals at Kingston-upon-Thames, Mr. J. F. Roper, regional engineer of the British Lighting Council, says that trolley-bus standards are unlikely to be in suitable positions for this purpose. He points out in a letter to the *Surrey Comet* that the effectiveness of a street-lighting installation is determined by the success achieved in revealing to the road user the road ahead and its hazards and is very dependent upon the positioning of the lanterns. This applies particularly on curves and at road junctions.

* * *

I read in the *Edison Electric Bulletin* (New York) that "the total electric concept of the home was stressed at the Live Better Electrically Women's Conference in Chicago, Jan. 12-14, as the stimulant needed by the electric industry and its allies to create a new upward trend in the present building slump." It appears that special attention was paid at the conference to the promotion of electric heating. This is described in another article in the *Bulletin* as the cornerstone of the electric living concept. There is no suggestion in the article that heating should be regarded as an off-peak load; in fact it is said that many electrical "utilities" are offering special rates for heating during normal hours. Stress is being laid in advertisements on the "flamelessness" of electric heating—as well as cooking and water heating.

* * *

The annual report of the Electricity Consultative Council for the North of Scotland District mentions an unusual example of a "Do it yourself" suggestion:—

"A potential consumer, who complained that the capital contribution quoted to him was excessive, offered to erect the service line himself if the Board would supply the materials. He has been quoted alternative costs for his assisting with the erection of a line for the Board and for erection by himself of a private line."

* * *

Threatened with disconnection unless he pays his electricity bill within seven days, a Towcester consumer writes to the *Chronicle and Echo* (Northampton) to utter a counter-threat to the East Midlands Electricity Board. He intends, and calls upon others to do likewise, to confine his business with the Board to the purchase of electricity.

He will purchase any electrical goods or appliances only from private sources. This may not shake the Board very much but it should gladden the hearts of local electrical retailers.

* * *

I reproduce with the kind permission of the Editor of *London Electricity* a sketch illustrating an article entitled "Meter Reader's Notebook" by Bill Reilly in the March issue. It is explained by the opening sentence of the



article:—"It goes without saying that meter readers should always regard as private and confidential whatever they may see or hear in other people's homes in the course of their duties."

* * *

Now that electricity charges are much in the news the following note from the *Electrical Review* of 8th March, 1901, is of interest:—

"Glasgow.—A curious state of things reigns in the model city. The charges for electricity are 6d for the first hour and 1½d afterwards, but a consumer who guarantees to use his maximum demand five hours per day the year round is charged 1½d per unit only. Hence a three- or four-hour consumer actually makes a profit by keeping his maximum load on for five hours, whether he wants the energy or not! According to one of the Councillors, Mr. Burrell, this has become known, and is being done by some of the acute business men of Glasgow."

PERSONAL AND SOCIAL

News of Men and Women of the Industry

At a meeting of the Council of the Institution of Electrical Engineers last week **Lord Nelson of Stafford, LL.D.**, chairman of the English Electric group of companies, was elected to honorary membership in recognition of his outstanding contribution to the development of electrical science and engineering, and for his many services to the Institution. Lord Nelson achieved the rare distinction of serving both as president of the I.E.E. (1955-56) and of the Institution of Mechanical Engineers (1957-58). He has also been president of the Locomotive and Allied Manufacturers' Association (1958) and of the Federation of British Industries (1943-45). He is a Governor of Queen Mary College, University of London, and an honorary member and fellow of the Imperial College of Science and Technology. In 1957 he received the honorary degree of Doctor of Laws from the University of Manchester. Last May he was installed as Prime Warden of the Goldsmiths' Company.

Lord Nelson was created a baronet in 1959 and raised to the peerage in the New Year Honours of 1960. His association with the English Electric Co., Ltd., began in 1930 when he was appointed managing director, becoming chairman three years later.

The I.E.E. Council has made the thirty-ninth award of the Faraday Medal to **Mr. Julius A. Stratton, Sc.D., LL.D.**, president of the Massachusetts Institute of Technology, for his notable contributions in the fields of technological education and research in radio communication. Dr. Stratton joined the M.I.T. as a research associate in communications in 1924 and among the positions which he subsequently held were those of assistant professor of electrical engineering, professor of physics, vice-president and chancellor. He made an outstanding contribution to the theory of transmission line, waveguide and antenna systems in relation to the wartime development of centimetre-wave radar and he also inspired the movement within the

M.I.T. towards a thorough revision of the engineering undergraduate courses.

The Minister of Power has re-appointed **Mr. J. F. Stanier** as a part-time member of the East Midlands Electricity Board and **Mr. E. J. Hunter, C.B.E., J.P.**, and **Mr. E. T. Judge, M.A.**, as part-time members of the North Eastern Electricity Board.

Mr. L. F. Anderson, of Hornchurch, Essex, has been appointed a member of the Eastern Electricity Consultative Council. **Mr. A. N. East, C.B.E., M.I.E.E., M.I.Mech.E.**, of Abbots Langley, Herts., has ceased to be a member of the Council.

Viscount Chandos, chairman, Associated Electrical Industries, Ltd., has been re-appointed president of the Locomotive and Allied Manufacturers' Association of Great Britain, and **Mr. G. Collingwood**, managing director, Vulcan Foundry, Ltd., has been re-appointed chairman for the ensuing year.

Councillor Peter Meldrum (Glasgow) has been appointed by the Secretary of State for Scotland as a part-time member to fill a vacancy on the South of Scotland Electricity Board for the period to 31st December, 1963.

Atlas Lighting, Ltd., have appointed **Mr. R. S. Pryor** as sales supervisor for their Photographic Department.

Mr. H. Brook has been appointed sales manager of the L. S. Starrett Co., Ltd., Jedburgh, Scotland, newly formed subsidiary of the United States precision tool and saw manufacturing concern of the same name. Mr. Brook was formerly northern sales manager for S. N. Bridges & Co., Ltd.

The North Western Branch of the **Electrical Trades' Commercial Travelers' Association** held their ladies' evening on 24th February in the Windermere Suite, Belle Vue, Manchester. Mr. H. Chadwick, Branch chairman, welcomed members and their friends and said the attendance was the best since this function was

first held. Among those present were Mr. D. H. Hyde, national chairman, Mr. S. W. Graefe, chairman, Midlands Branch, and Mr. R. H. Corlett, immediate past-chairman of the Association.

Mr. F. J. Feltoe, B.Sc., A.M.I.Mech.E., A.M.I.E.E., has been appointed chief fuel and power engineer and **Mr. J. W. Oswald, B.Sc., A.M.I.E.E.**, chief electrical engineer at the new Spencer Works of Richard Thomas & Baldwins, Ltd., under construction at Llanwern, near Newport, Mon.

Mr. Feltoe, who is 36, began his career with C. A. Parsons & Co., Ltd., as a graduate apprentice and draughtsman. In 1949 he moved to Abbey Works, Margam, as a site engineer for McLellan & Partners and subsequently held appointments with the Steel Company of Wales as a power plant engineer and with Unilever as an area engineer.

Mr. Oswald was born in 1923 in Shanghai and educated at Bradfield College and Edinburgh University. He served his apprenticeship with B.T.H. at Rugby, and in 1949 joined McLellan & Partners. During the last twelve years he has been closely associated with the Steel Company of Wales developments and with the development of the Richard Thomas & Baldwins Works at Ebbw Vale.

The Solartron Electronic Group, Ltd., announces the appointment to the board of **Mr. R. Catherall, B.Sc. (Elec. Eng.)**, who becomes director of research and development; **Mr. L. Malec, M.B.E.(Mil.)**, as director of systems sales; and **Mr. H. D. Binyon** as director of product sales.

Mr. Catherall joined Solartron Laboratory Instruments, Ltd., in 1952, and was responsible for the development of the transfer function analyser.



Lord Nelson



Mr. R. Catherall



Mr. L. Malec



Mr. H. D. Binyon

In 1957 he was appointed director of Solartron Research & Development, Ltd. He previously held appointments with Rotol, Ltd., Parsons Marine Engineering Turbine Research and Development Association and S. Smith & Sons (England), Ltd.

Mr. Malec joined the group two years ago as managing director of Solartron Radar Simulators, Ltd. Mr. Binyon was the first sales representative of Solartron Laboratory Instruments, Ltd., and later became sales manager; he was appointed a director in 1955. Previously he had been at the Cavendish Laboratories, Cambridge, and with Elliott Bros. (London), Ltd., and Muirhead & Co., Ltd.

Mr. J. E. Shepherd, M.I.E.E., A.M.C.T., manager of the North Western Electricity Board's No. 6 (Lakeland) Sub-Area since it was formed in 1948, retired at the end of last month. His successor is **Mr. J. Mills**, A.M.I.E.E., A.M.I.Mech.E., A.M.C.T., M.Inst.F.

Mr. Shepherd began his career as an apprentice with Whipp & Bourne, Rochdale, and then joined the Rawtenstall (Rossendale) undertaking, of which he became chief engineer in 1930. In 1937 he was appointed

Electricity Board. Before taking up his new appointment he was manager of the Board's No. 7 Sub-Area at Hazel Grove, Ches.

Mr. K. A. Robinson, A.M.Brit.I.R.E., has been appointed to the board of Lancashire Dynamo Electronic Products, Ltd. (Metal Industries Group). Mr. Robinson, who is 34, joined the company as chief development engineer in 1948 and in 1959 he was appointed chief engineer.

Mr. Graham Cooke has been appointed group publicity director of the Firth Cleveland Group.

Mr. H. J. Wigner has been appointed sales manager and **Mr. E. Mason** chief engineer of Expert Industrial Controls, Ltd. Mr. Wigner was previously field sales manager and Mr. Mason chief draughtsman of the company.

Mr. F. Ainscow is retiring from the board of W. H. Smith & Co. Electrical Engineers, Ltd., after 30 years' service with the company.

Mr. R. M. Fairfield, assistant managing director of British Insulated Callender's Cables, Ltd., has been appointed a director of Submarine Cables, Ltd., owned jointly by B.I.C.C. and Associated Electrical Industries, Ltd. **Mr. H. F. Wilson** is retiring from the board of Submarine Cables, Ltd.

Councillor P. A. L. Hodges, senior showroom supervisor with the South Eastern Electricity Board at Epsom, Surrey, is to be Mayor of Epsom and Ewell next year.

Mr. L. F. Bull has been appointed a director of Osma Plastics, Ltd. He has been general manager (production) since 1957.

The annual meeting of the **Birmingham Electrical Golfing Society** was held on 28th February last. The president, Mr. P. M. King, reported that membership had once again increased and the captain, Mr. J. T. Aitken, said that the matches during the season had been well supported by members. Mr. F. C. Mealing, who has resigned from the position of hon. secretary/treasurer for health reasons, was warmly thanked for his work for the Society since its formation and members expressed their good wishes for his speedy recovery. The officers and committee elected for 1961-62 are as follows:—President: Mr. J. T. Aitken; captain: Mr. H. Martin; committee: Mr. H. G. Noake and Mr. S. C. Tutton; and hon. secretary/treasurer, Mr. J. Bleiner. Membership application forms are available from Mr. Bleiner at 109, Danford Lane, Solihull.



Mr. B. L. Bardell



Mr. N. H. Olley

Mr. B. L. Bardell, chief electrical engineer, and **Mr. N. H. Olley**, chief design engineer, have been appointed joint technical directors of M.T.E. Control Gear, Ltd.

Mr. Clifford Metcalfe, C.B.E., is relinquishing his position as managing director of E.M.I. Electronics, Ltd., at his own request on 1st July. He will remain a full-time director of Electric & Musical Industries, Ltd., and will devote his main attention to initiating technical and development policy for new products. He is to be succeeded as managing director of E.M.I. Electronics, Ltd., by **Mr. Percy A. Allaway**, who has been deputy managing director since 1957 and was previously works director.

Mr. L. J. T. Weston, A.M.I.E.E., Suffolk Sub-Area construction engineer of the Eastern Electricity Board, is going to Italy in October and will stay with the Societa Edison Milan for two months. The visit has been arranged by the Electricity Council under an exchange scheme.

Mr. N. T. Evans, A.M.I.E.E., has recently been appointed technical manager of Scull Electrical, Ltd. Before joining the company two years ago Mr. Evans was senior contracts engineer with the Colston Electrical Co., Ltd.

Mr. R. S. Montgomerie, London area manager of the E.M.B. Co., Ltd., is retiring at the end of April owing to indifferent health, but will continue to serve the company on a part-time basis. **Mr. P. N. Jay**, Mr. Montgomerie's assistant, will become the London area manager.

Mr. C. T. Roberts, B.Sc.(Eng.), M.I.Mech.E., M.I.Loco.E., has been appointed chief mechanical and electrical engineer, Scottish Region, British Railways. Mr. Roberts was formerly principal assistant mechanical and electrical engineer at Swindon.

Mr. K. Clark has been promoted to the new position of assistant export manager, Acheson Colloids, Ltd., a subsidiary of Acheson Industries (Europe), Ltd. **Mr. C. R. Wills**,



Mr. J. E. Shepherd

Mr. J. Mills]

borough electrical engineer at Barrow-in-Furness, where he remained until the industry was nationalised. He has served on many committees connected with the industry. He is a past-chairman of the North Western Area of the Electrical Development Association and was for many years on the Association's National Rural Electrification Committee. He is a member of the British Standards Institution's Committee on International Voltages and Frequencies.

Mr. Mills was originally with the Lancashire Electric Power Company and he moved in 1936 to Bradford where he was generating engineer at the Valley power station. Returning to Lancashire in 1943, he became station superintendent and later deputy borough electrical engineer at St. Helens. He was subsequently borough electrical engineer of Bury and purchasing officer to the North Western

general manager of Acheson Colloids, Ltd., will temporarily assume the additional responsibilities of export manager.

Mr. D. A. Leitch, formerly Scottish area manager of CIBA (A.R.L.), Ltd., has been appointed Southern area manager; **Mr. L. W. Taylor** becomes Scottish area manager; and **Mr. J. M. Turner**, Midlands area manager.

Mr. R. H. Hudson, export manager of Dimplex, Ltd., is making a nine-week overseas tour in connection with the company's export sales drive. He is visiting Germany, Denmark, Japan, Hong Kong, Australia, New Zealand, the United States and Canada.

The annual dinner-dance of the **Norfolk Electrical Circle** was held at Norwich on 1st March and was attended by over 400 people. The Circle chairman, **Mr. H. E. Hudson**, of Gorleston, was supported by the president, **Mr. J. A. Sumner**, and most members of the Circle and their ladies. Amongst the guests, headed by the Lord Mayor and Lady Mayoress, were the Town Clerk and Chief Constable of Norwich. There were many senior representatives of manufacturers and the chairman, deputy chairman, chief engineer and chief commercial officer of the Eastern Electricity Board were present. The Lord Mayor spoke of his desire that in the University soon to be established in Norwich there should be a chair of electronics (not an "electric chair" as had been suggested to him).

OBITUARY

Mr. S. Chase.—The death occurred on 12th February of **Stephen Hayter Chase**, M.I.E.E., formerly manager, stationary battery sales, with Chloride Batteries, Ltd. Mr. Chase joined Chloride as sales engineer in 1923, having previously studied electrical engineering at Finsbury Technical College. Throughout his career with the company he was connected with stationary battery sales and for many years was sales manager in London and South-East England. In 1950 he became assistant sales manager, Stationary Battery Division, for Great Britain and in 1956, the year before his retirement, he assumed full responsibility.

Mr. J. T. Morgan.—We regret to report the death, on 27th February, of **Mr. John T. Morgan**, who had been secretary of the Association of Electrical Machinery Trades since its formation in 1944.

Mr. E. Edwards.—The death occurred at Bexhill on 26th February of **Mr. Ernest Edwards**, M.I.E.E. He was 88.

PARLIAMENTARY REPORT

Block Storage Heaters

The Chancellor of the Exchequer told the House of Commons last week that he could not consider freeing electric block storage heaters from purchase tax. **Mr. Selwyn Lloyd** said he was fully aware of the importance of the off-peak use of electricity. He knew that manufacturers had not hitherto sold block storage heaters for domestic use, though he believed consultations were proceeding with them about the prospects of producing models which would appeal more specifically to the domestic consumer.

Mr. A. Woodburn said that both the Electricity Boards and the trade were convinced that such action would make a very big contribution to the reduction of peak load. The economies to the nation of a reduction of the peak load would be commensurately much greater than they would be by a reduction in the consumption of electricity at any other time.

Mr. Lloyd said it would be a very new principle to say before an article was produced that one of the terms of its production was that there should be no purchase tax on it.

Refusal to Release Army Officer

The reasons why 2nd Lieut. **R. M. Bentley**, of the 3rd Training Batt., R.E.M.E., who had specialised knowledge of high voltage techniques, was refused release from the Army at the request of Doulton Industrial Porcelain, Ltd., were given by the War Minister, **Mr. Profumo**, in a written answer. He said that many applications were made for the premature release of National Service officers so that they could return to their previous

civilian employment. It was quite impossible to spare them all. It had been Government policy only to release early those National Service officers whose retention would cause undue hardship to themselves or their dependants.

The question by **Commander Courtney** stated that Lieut. Bentley's knowledge was needed for development work connected with the export trade.

The Dounreay Reactor

The Parliamentary Secretary to the Minister for Science, **Mr. Denzil Freeth**, stated in another written reply that work at the atomic energy station at Dounreay, though widely diversified, was mainly concerned with developing the fast reactor system. The main problems encountered since the reactor "went critical" in November, 1959, had not been concerned with the nuclear side of the experiment. A series of low power tests in the megawatt range would shortly begin. The reactor would then gradually be worked up to full power.

Low-Power Reactors

Mr. Freeth indicated that he hoped to make a statement shortly on the question of giving permission for one or more of the university colleges of science and technology to build a low-power nuclear reactor.

Electricity Bill

The Electricity (Amendment) Bill received the Royal Assent on 2nd March. It empowers the Central Electricity Generating Board to produce and sell radioisotopes.

Inquiry into Scottish Electricity Supply

A Departmental Committee is to be set up to review the general arrangements for generating and distributing electricity in Scotland, **Mr. J. S. Maclay**, Secretary of State for Scotland, announced in the House of Commons on Tuesday. **Mr. Colin H. Mackenzie**, former chairman of the Scottish Committee of the Federation of British Industries, is to be the chairman. Other members of the Committee will be **Sir Josiah Eccles**, deputy chairman of the Electricity Council; **Prof. Alan Peacock**, Professor of Economics at Edinburgh University; **Mr. James Keyden**, director and general manager, Pressed Steel Co.; **Mr. James Craig**, county clerk of

Aberdeen; and **Mr. James Grant**, editor of the *Stornoway Gazette*.

The Committee will review the arrangements for generating and distributing electricity in Scotland, having regard to (1) the availability and costs of hydro-electric power and of other sources of electricity; (2) the rate of increase in the demand for electricity; and (3) the needs of the remoter areas.

Mr. Maclay said that the Committee would report in six to nine months and the report would be published. In reply to a question he said that no final decision to proceed with the Glen Nevis scheme would be made until the Committee's report had been considered.

INDUSTRIAL NEWS

Investment Opportunities in Nigeria

THE establishment of a factory in Nigeria to manufacture plastic insulated electric cables is under consideration by British Insulated Callender's Cables, Ltd., in collaboration with Associated Electrical Industries, Ltd. This would represent an investment of about £250,000.

This was revealed by the Federation of British Industries mission which visited Nigeria in January to study investment prospects, when they reported back at a Press conference last week. Two other electrical firms, Joseph Lucas, Ltd., and the Chloride

Electrical Storage Co., Ltd., through their joint overseas company, have indicated their intention of putting forward proposals for the manufacture of lead acid batteries. The project has not yet reached the stage where figures of employment and investment can be given.

In their report (*Nigeria—An Industrial Reconnaissance*, price 7s 6d) the mission say that the main impetus to a virile local industry will only be achieved when the cost of electricity is reduced. This important aspect must be taken into account when considering the Niger dam proposals. The cable factory could be expanded to produce a limited range of telecommunications cables and "this project might well be associated with discussion which should take place and which we would help to initiate with a consortium of British manufacturers interested in telecommunications."

At the Press conference it was stated that £5 million was needed to finance the development of telecommunications during the next three years and a further £30 million in the period up to 1970. If the capital could not be provided by this country, Nigeria would turn to the United States and American systems would be installed.

PLASTIC SLEEVING PROTECTS CABLES

FUMES emitted by trains passing under a bridge at Lodge Road, London, N.W.8, caused acute corrosion in the mild steel pipes encasing three 66 kV two-core oil-filled cables and associated pilot cables laid under the south footway and supported by mild steel r.s.j.'s suspended from the main bridge girders. During bridge rebuilding, the C.E.G.B. decided to replace the steel pipes with plastic sleeving. The job was undertaken for the Board by Durapipe & Fittings, Ltd.

The h.v. cables, which were first served with a bituminous hessian covering, weighed 70 lb/yd and measured 4.14in outside diameter. Thirty-six 10ft lengths of thermoplastic piping with a bore of 6.06in and wall thickness of approximately $\frac{9}{32}$ in were used. The piping was supported at 5ft intervals by r.s.j.'s of 4½in bearing and held in place by galvanised iron U-bolts.

Steelworks Power Station Extension

The Mitchell Construction Co., Ltd., has been awarded a contract for the construction of an extension to the power station of the Workington Iron & Steel Co. (branch of the United Steel Companies, Ltd.). The contract, which amounts to about £150,000, covers the construction of a steel framed brick power station on a bored piled foundation to house a turbo-alternator set and ancillary buildings for transformers, switchgear, etc. The engineering agents for the design and construction of the extension are the Parolle Electrical Plant Co., Ltd., and Messrs. R. T. James & Partners have been appointed consulting engineers for the civil engineering works.

Higher Charges in Yorkshire

In announcing the upward revision of their retail tariffs to preserve a minimum level of internal financing the Yorkshire Electricity Board point out that the increased costs, amounting to nearly £1.5 million, which have arisen during the past financial year completely wipe out the surplus for the previous year on current account. In addition to the foregoing increases, which will have greater effect in 1961-62 because of the full year's operation, the Board are faced with an increase in the bulk supply tariff which amounts on current estimates to a further £1.2 million for the year 1961-62. A realistic assessment of the position, they state, must therefore take account of additional costs totalling about £3.5 million per annum, excluding coal costs recovered under two-part tariffs. Off-peak flat-rate tariffs are not being increased.

Technological Book Exhibition

An exhibition of technological books, organised by the Technical and Scientific Group of the Publishers' Association, will be held at the Engineering Centre, Stephenson Place (outside New Street Station), Birmingham, from 14th to 16th March inclusive. Some 750 titles will be on show, representing 37 different publishers, including many on electrical subjects.

Sir Christopher Hinton at B.I.C.C. Works

Last Friday Sir Christopher Hinton, K.B.E., F.R.S., chairman of the Central Electricity Generating Board, visited the Erith Works, Belvedere, Kent, of British Insulated Callender's Cables, Ltd. We reproduce a photograph taken during the visit. The factory is

the headquarters of the B.I.C.C. Group Power Cables Division and it is claimed to be the largest and most modern plant in the world for the design, manufacture and testing of power cables for all voltages up to 400 kV.

Left to right: Mr. O. W. Minshull, general manager, B.I.C.C. Power Cables Division, Erith; Sir Christopher Hinton; Mr. R. M. Fairfield, assistant managing director, B.I.C.C.; and Mr. D. T. Hollingsworth, director, B.I.C.C.

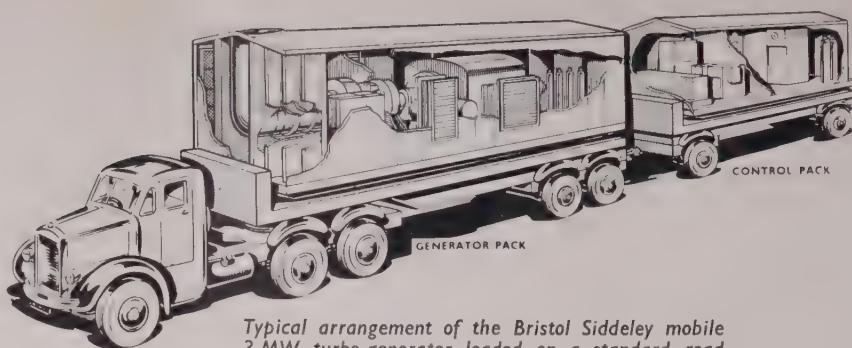


INDUSTRIAL NEWS *[continued]*

Mobile Power Unit

AN economic self-contained power unit consisting of a Bristol Siddeley Proteus gas turbine driving an Electric Construction Co. 3.75 MVA generator has been designed by the Power Division of Bristol Siddeley Engines, Ltd. In effect, the generating set is a portable version of the 3 MW power stations already in service with the South Western Electricity Board, see *Electrical Review* of 18th December, 1959.

The mobile unit can be mounted on a standard road transporter or railway flat car and can be put into service without off-loading or jacking. The



Typical arrangement of the Bristol Siddeley mobile 3 MW turbo-generator loaded on a standard road transporter. The Proteus gas turbine engine and the alternator are contained in a 34ft long, 9ft high and 9ft wide unit. The control pack is 17ft in length

basic engine generator unit is a completely self-contained automatic, remotely controlled set, independent of all outside equipment or water supplies. A fuel control system has now been designed permitting the use

of natural gas with no loss of performance.

A typical set would consist of two units, the generator pack and the control pack. The generator pack is divided by a fireproof bulkhead into two compartments, one of which houses the "hot" end of the Proteus turbine while the other contains the reduction gear, the alternator and ancillary equipment. The control pack is required only if suitable control equipment is not available at the site where the set will operate.

RADIATION CATERING EQUIPMENT

THE name of Fletcher, Russell & Co., Ltd., a subsidiary of Radiation, Ltd., has been changed to Radiation Catering Equipment, Ltd., which also incorporates the previous activities of Radiation (Large Cooking Equipment), Ltd. The new company will design, manufacture and sell an increasingly wide range of Radiation catering equipment for all types of fuel. In addition to supplying equipment for hotels, restaurants, industrial canteens, hospitals, etc., it will also provide equipment for specialised industries such as railway restaurant cars, shipping, etc. The directors are Mr. W. D. King (chairman of the parent company), Mr. F. P. S. Stammers (managing director of the new company), Messrs. A. J. Parker, S. L. Pleasance and S. J. Stanbrook (directors of the parent

company) and Mr. A. O. Russell (general sales manager of the new company).

New Appliances Displayed

Among a number of newly-introduced appliances shown by General Trade Equipment, Ltd., 82-90, Seymour Place, London, W.1, last week was the "Compacta" three-in-one kitchen unit consisting of a cooker with four 1,500 W boiling plates, a 5 cu ft refrigerator, and a kitchen sink. Other items were a battery-operated pepper mill; a new American portable industrial mixer for cement, concrete, plaster, plastics, etc.; a transistor medium-wave pocket radio receiver; and the "Waring blender" for kitchen use.

Prices of Materials

In the accompanying table we give the basis prices of the more important materials used in the electrical

ALUMINIUM ingots	ton	£186	os	od
COPPER, H.C. Electro	ton	£225	10s	od
Fire Refined 99.70%	ton	£224	os	od
Fire Refined 99.50%	ton	£223	os	od
COPPER Tubes	lb	2s	2½d	
Sheet	ton	£262	10s	od
H.C. wire and strip	ton	£278	5s	od
LEAD, English	ton	£65	5s	od
Foreign	ton	£64	os	od
MERCURY	flask	£69	os	od
TIN, block (English)	ton	£803	os	od
ZINC, G.O.B. Foreign	ton	£84	10s	od
BRASS Tubes (solid drawn)	lb	1s	10d	
Wire	lb	2s	8½d	
PHOSPHOR BRONZE				
Wire	lb	4s	1½d	
PLATINUM	oz	£30	5s	od
RUBBER, No. 1 R.S.S. spot	lb	25½d—25½d		

Analysis of Electricity Sales

THE accompanying table issued by the Electricity Council shows the sales of electricity to the principal classes of consumers during the quarter and year

ended 31st December, 1960, with an indication of the percentage changes. The figures relate to kWh metered or billed during the period concerned.

Class of Consumer	Three months ended 31st December, 1960 Million kWh	Increase over corresponding quarter of 1959 %	Twelve months ended 31st December, 1960 Million kWh	Increase over previous year %
Domestic ...	7,275.1	+ 22.5	30,107.6	+ 15.8
Farm ...	444.8	+ 33.7	1,724.9	+ 15.3
Commercial ...	2,993.3	+ 18.4	11,628.4	+ 13.5
Combined Domestic/ Commercial ...	367.4	+ 18.5	1,523.8	+ 13.6
Industrial ...	12,337.3	+ 8.2	46,283.2	+ 12.0
Public Lighting ...	244.4	+ 8.7	771.2	+ 8.3
Traction ...	407.5	+ 1.9	1,569.3	+ 2.6
TOTAL ...	24,069.8	+ 13.8	93,608.3	+ 13.3

industry. The figures given are the selling prices and are those quoted on Tuesday last.

Refrigerator Makers' Longer Week

After working a four-day week for the past two months or so, operatives at the Bognor Regis factory of Lec Refrigeration, Ltd., are reverting to a five-day week. About a third of those concerned, approximately 1,000, began the longer week last Friday and a further half are to resume today.

FOR MODERN BUILDINGS

The continual increase in the use of electric power consuming devices in all types of buildings calls for well designed distribution equipment of proved performance. 'ENGLISH ELECTRIC' meet these requirements with their 'Superform' Switchboards and 'Red Spot' Fuseboards.

EASY TO INSTALL • EASY TO MAINTAIN
SAFE TO OPERATE • OF PLEASING APPEARANCE

'SUPERFORM' SWITCHBOARDS

These switchboards have all the 'live' metal insulated, including busbars, interconnections, cable terminations, instrument and meter terminals, switch contacts and terminal blocks. Thus spare switches included on the switchboard can be cabled up safely with the existing circuits in operation.



'RED SPOT' FUSEBOARDS

Designed with concealed hinges and push button door catch having provision for locking by means of a built-in cylinder lock, 'Red Spot' fuseboards have the busbars and incoming cable sockets fully insulated. The fuse contacts and fuse terminals are covered by insulated shrouds. These features provide safety to electrical personnel by enabling spare fuseways to be cabled up with the busbars alive.



FOR DESCRIPTIVE LITERATURE WRITE TO:

The English Electric Company Limited,
 Fusegear Division,
 East Lancashire Road, Liverpool, 10

'ENGLISH ELECTRIC'

fusegear

THE ENGLISH ELECTRIC COMPANY LIMITED, ENGLISH ELECTRIC HOUSE, STRAND, LONDON, W.C.2
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Refer to Bulletin No. SR2005

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INDUSTRIAL NEWS *[continued]*

M. & I. Diamond Jubilee

ALTHOUGH the founders of the business began distributing micanite in this country and Europe in 1895, the Micanite & Insulators Co., Ltd., dates its history from 1901 when the company was formed under the title of the Micanite Insulator Co. Consequently M. & I. celebrates its diamond jubilee this year.

Sixty years ago production processes were somewhat crude. Micanite V-rings up to 55in in diameter were made; moulds were heated on open coke fires or, if small enough, over a gas ring in a biscuit tin. Nevertheless some of the original rings supplied for traction and other motors remained in continuous operation for half a century.

The company's title was altered to its present style in 1906. Later the manufacture of Empire varnished insulation was commenced, to be followed by the introduction of synthetic resin bonded laminates under the trade name "Paxolin." Subsequent developments included the production of bushings for up to 100 kV and later for 132 kV; "Panilax" aniline-formaldehyde resin; the formation of the subsidiary, British Tego Gluefilm, Ltd.; the use of silicones



The original M. & I. offices at Stansted, Essex

with mica or glass to produce insulation for high-temperature use; "Samacanite" mica-paper insulation;



2,500 kV surge generator equipment in the e.h.v. test building, Walthamstow

and generally keeping up with the advances in the generation, transmission and use of electricity.

Copper Utilisation Symposium

A SYMPOSIUM on recent developments in the use of copper in the electrical industry, organised by the Copper Development Association, was held in London last October and a full report of this meeting has recently been published by the Association. It contains the four papers which were presented—dealing with the economic use of copper in power transformers, cooled copper conductors for electrical equipment, the use of copper material

for waveguide construction and copper alloys for conductivity applications—as well as all the questions, answers and comments which occurred during the discussion period. Copies of the report are available from the Association at 55, South Audley Street, London, W.1.

ANGLO-U.S. MICROWAVE DEAL

Elliott-Automation, Ltd., and Litton Industries, Inc., of Beverly Hills, California, have announced the conclusion of negotiations for co-operation in the microwave valve field. A new £400,000 company, Elliott-Litton, Ltd., is being formed to assume responsibility for the principal British and Commonwealth interests of the Electron Tube Division of Litton Industries and the microwave valve business of Elliott Brothers (London), Ltd., a member of the Elliott-Automation Group. The new company will have its offices and factory at Manor Way, Boreham Wood, Herts.

Liverpool Town Hall Rewiring

The wiring of Liverpool Town Hall is to be renewed, the four lifts are to be modernised and fire-detector equipment installed at a figure approaching £20,000. While the rewiring work is in progress, the system of supply will be changed from a.c. to d.c. at a cost of £9,735. The scheme for the modernisation of the electrical equipment has been approved in principle.

Transformer for Ffestiniog



A 123 ton Ferranti generator transformer for the Ffestiniog pumped storage scheme crossing a bridge near Bettws-y-Coed on its way from Llandudno Junction to Blaenau Ffestiniog by special train

INDUSTRIAL NEWS *[continued]*

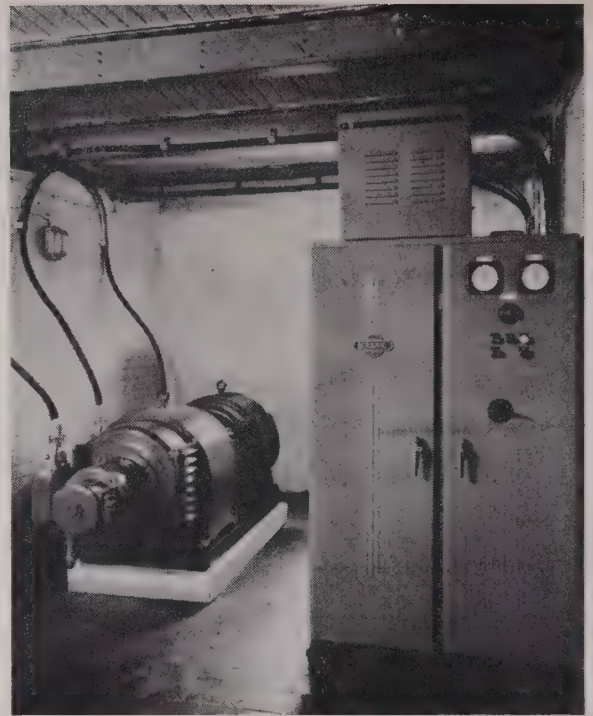
Speed Control System

A NEW variable speed drive has recently been installed for an existing 120in paper making machine at the Alders (Tamworth), Ltd., paper mill at Tamworth. The new drive was required to improve the regulation, so that the change in speed with load variations could be reduced, and also to raise the maximum speed of paper making from about 360 ft/min to a little above 500 ft/min.

Equipment consisting of a 95 h.p. 0/500 V forced ventilated d.c. motor having a speed range of 1,600/320/150 r.p.m. by Ward-Leonard control was supplied by Crompton Parkinson, Ltd. This motor drives a line shaft by means of vee-belts and the line shaft in turn drives the various sections of the machine through pneumatic clutches. The necessary d.c. power for the variable speed motor is provided by a two-machine motor-generator set comprising an auto-synchronous unity power factor motor with overhung exciter, driving a 0/500 V d.c. shunt wound separately excited generator.

The control gear for the d.c. side of this Ward-Leonard system was provided by Brookhirst Igranic and consisted of a main control cubicle together with a small remote control station. The equipment was intended to give two forms of control. The first of these is very similar to conventional Ward-Leonard equipment in that the main magnetic amplifier is controlled by a hand rheostat to give a variable voltage output to the main generator field thus controlling the speed of the machine, but without incorporating the feed-back circuit for improved speed

Ward-Leonard generator set and main control cubicle at Alders (Tamworth), Ltd., paper mill



regulation. The other form of control, which will normally be used, makes use of a servo principle of operation in which the motor speed is not controlled directly by the speed setting device but is governed indirectly by the error which exists between the desired speed and the actual speed which in this case is measured by a tachometer generator mounted at the non-driving end of the main variable speed motor. A two-stage magnetic amplifier is used to control the generator field and for reference purposes zener diodes are incorporated.

The original specification called for

the speed to be held within ± 1 per cent of the preset figure despite changes of ± 10 per cent in load or $\pm \frac{1}{2}$ c/s in frequency on the a.c. supply to the synchronous motor. In fact, the results obtained were much closer than those specified, the speed regulation being within approximately $\pm \frac{1}{2}$ per cent.

E.R.A. Switchgear and Transformers Committee

THE Electrical Research Association announces the composition of Divisional Committee No. 3—Switchgear and Transformers for Power Supply—which recently held its inaugural meeting. The members are:

Messrs. J. Christie, chairman (A. Reyrolle & Co., Ltd.); R. R. B. Brown (Southern Electricity Board); D. M. Cherry (Central Electricity Generating Board); J. S. Cliff (General Electric Co., Ltd.); T. E. Daniel (North Western Electricity Board); J. L. Egginton (C.E.G.B.); J. M. Ferguson (English Electric Co., Ltd.); C. H. Flurscheim (Associated Electrical Industries (Manchester), Ltd.); C. C. Hill (Eastern Electricity Board); R. M.

Hobill (Ferranti, Ltd.); Dr. S. Jones (C.E.G.B.); H. Leyburn (A. Reyrolle & Co., Ltd.); A. E. Nicol (Hackbridge & Hewitt Electric Co., Ltd.); E. C. Rippon (C. A. Parsons & Co., Ltd.); T. R. Warren (South of Scotland Electricity Board); and T. W. Wilcox (Merz & McLellan).

Dr. H. G. Taylor, director of the Electrical Research Association, is an ex officio member of the Committee, and the secretary is Major E. D. Gardner of the E.R.A.

"PEGASUS 2" COMPUTER

A 32-page booklet (D.C.44) describing the "Pegasus 2" computer system has recently been published by Ferranti, Ltd. It describes the main features of the computer both in its basic form and when used as a data-processing system. After a brief description of the computer itself there are sections on the common language and direct data-processing systems, punched card working, high-speed printing, magnetic tape working, pseudo off-line working, data representation and the combination of the main and computing stores. There are a number of appendices dealing with the programming facilities in greater detail.

£1.7 Million Radar Defence Order

The Royal Swedish Air Board has placed a further contract to the value of £1.7 million with Marconi's Wireless Telegraph Co., Ltd., for the supply of electronic equipment for the air defence system.

Airport Lighting in Yugoslavia

The Yugoslav authorities have just placed a further order for airport lighting equipment with the General Electric Co., Ltd., making the total value of the contracts over £100,000. The new contract is for a complete airfield lighting installation and covers high-intensity runway and approach lights, taxiway lights, transformers, constant-current regulators, switchgear and control gear.

Transmission at 400 kV

THERE was no substantial economic advantage to be gained from operating at 400 kV, but clearly the policy would result in fewer lines as the system grew and this was evidence that the Generating Board was very concerned with amenity values. This point was made by Mr. O. S. Woods, divisional controller of the C.E.G.B. East Midlands Division, in a talk on future power development at a meeting of the East Midlands Electricity Consultative Council last week.

Mr. Woods said that of the 2,000 MW of new plant commissioned by the Generating Board last year, 40 per cent was in the East Midlands Division. It was cheaper to transmit electrical energy over a distance of 50 miles than to take coal to power stations which were local to the load. The main function of the 275 kV supergrid was to interconnect large individual power stations and to tie groups or areas of the existing 132 kV grid thus permitting the bulk transmission of energy. The first step to meet increasing loads would be to re-insulate the 275 kV lines for operation at 400 kV, using the existing

towers and lines but increasing the power capacity by 66 per cent. The second step would be to erect new towers and lines to operate at 400 kV, but each of the power lines (phases) would consist of four conductors thus increasing the power capacity by 150 per cent compared with the original 275 kV circuit. He said that when the system was in operation it would be the highest voltage in commercial use in the world, except U.S.S.R., and its value to the electrical industry in world markets would be considerable.

It had to be stated that there was no technical difficulty in manufacturing underground cables suitable for operation up to 400 kV, but naturally the cost was prohibitive when compared with overhead lines and towers on the basis of equivalent capacity. The approximate costs per mile for a double circuit 400 kV line and underground cable were estimated to be £40,000 and £550,000 respectively.

In an address to the General Purposes Committee, Lord Citrine (Electricity Council) reviewed the progress of the electricity supply industry since the vesting date and paid a tribute to the work of the Consultative Councils.

TRADE ANNOUNCEMENTS

The costing department of **Peerless & Ericsson, Ltd.**, has been moved to the Kings Norton factory in Birmingham and the accounts department is now operating at the Woking, Surrey, head offices of the parent company, Kenwood Manufacturing (Woking), Ltd. Previously both departments were at 1, Carlisle Road, The Hyde, London, N.W.9, where the head sales office, service department and London area sales office remain.

White & Riches, Ltd., whose factory at Burgess Hill specialises in electronic equipment and light engineering, announce that they have acquired a factory at North Lane, Aldershot, and the business formerly owned by A. R. Wade, Ltd. Plans are already in hand for extending the plant, which will be used for the design and production of components for the aircraft and allied industries, as well as for the continued manufacture of "Wade" electric furnaces.

Walmore Electronics, Ltd., are expanding their activities in the field of electronic valves and semiconductor and have moved into larger premises at 11-15, Betterton Street, Drury Lane, London, W.C.2 (telephone: Temple Bar 0201-4).

George Kent, Ltd., has acquired a controlling interest in the Tieghi Company of Milan and Lenno. A new company, Kent-Tieghi S.p.A., has been formed and has purchased the whole of the assets and goodwill of the Tieghi Company.

Elliott-Automation, Ltd., announces that for certain applications joint marketing arrangements have now been made between the Rheostatic Co., Ltd., and Black Automatic Controls, Ltd., both member companies of the group. Under these arrangements

the Rheostatic Co. will sell Black solenoid-operated valves, pressure and flow switches to the heating, ventilating and air conditioning industries under the name "Black-Satchwell." A new sales office is being opened by Black Automatic Controls, Ltd., at Steel House, 11, Tothill Street, London, S.W.1 (Whitehall 5814-5).

The Brute Engineering Co., Ltd., 38, Dawson Street, Dublin, have been appointed sole agents in Eire for the L.E.W. group of companies, including the London Electric Wire Co. & Smiths, Ltd., Frederick Smith & Co. and the Vactite Wire Co., and will hold stocks of bare and covered wires in Dublin. They will also represent Printed Circuits, Ltd., and Millett Levens (Engravers), Ltd.

Lumenated Ceilings, Ltd., have opened a new area sales office and showroom at 10, Jesmond Street, Newcastle-upon-Tyne, 2 (telephone: 814301). The company's northern area representative is Mr. J. Hendry.

Dimplex, Ltd., have appointed B. J. Caraher (Distributors), Ltd., 26-28, Alfred Street, Belfast, 2, as their sole agents in Northern Ireland.

The address of the Purchasing Department of **Philips Electrical, Ltd.**, is now Berkshire House, High Holborn, London, W.C.1 (telephone: Gerrard 7777).

Pritchett & Gold and E.P.S. Co., Ltd., have transferred their Newcastle depot to more spacious and convenient premises at 20, Bankwell Lane, off High Level Bridge Approach, Gateshead-on-Tyne, 8 (telephone: Gateshead 70034).

From 4th April the address of **Livingston Laboratories, Ltd.**, will be 31, Camden Road, London, N.W.1 (telephone: Gulliver 8501).

H.M.V. Appliance Range to be Extended

Since the inclusion of Morphy-Richards, Ltd., within the E.M.I. Group a certain amount of rationalisation of development and marketing with the Gramophone Co., Ltd., has taken place. This, states the company, has apparently given rise to the suggestion that H.M.V. household appliances would be discontinued.

E.M.I. states that this is quite contrary to the facts and, in fact, the range of H.M.V. products is to be greatly extended particularly into the major appliance field.

TIN RESEARCH REPORT

In addition to general information about its organisation, the annual report of the Tin Research Institute for 1960, recently published, refers to the wide variety of inquiries received from industry on which information has been provided and also gives details of current research work being carried out. The subjects covered include hot tinning to impart good solderability to small components, and the structure of electro-deposited alloys. Copies of the report are available from the Institute at Fraser Road, Perivale, Greenford, Middlesex.

NEW ELECTRICAL EQUIPMENT

TELEVISION LIGHTING

A range of dust- and water-tight lighting fittings designed for use with closed circuit television installations in explosives factories, nuclear establishments, chemical plants, and similar situations has been introduced by P. W. ALLEN & CO., 253, Liverpool Road, London, N.1. One standard housing is made which takes one of the three basic types of lights, the focusing spot light, fixed focus spot light or floodlight. The lamps can be from 100 to 250 W according to camera lighting requirements and the permissible surface temperature of the light fitting. Mains or low voltage supplies can be used according to local needs.

The lamp body is in the form of a "top hat" section spinning in 16 gauge steel, 14 × 8½ in diameter. Riveted to the front flange is a machined cast aluminium ring 12 in in diameter and

screwed to this is another machined ring into which is cemented a 6 in diameter ¼ in thick glass window. For mounting, a ½ in spigot welded to one side fits a clamp which in turn fits over a 2 in diameter column, making the lamp fully adjustable in all directions. The prices vary according to the type of fitting supplied but normally range between £40 and £60 including the universal fixing clamps but without external wiring.

PREPAYMENT TIMER

A prepayment timer enabling consumers to buy electricity on a time basis is now available from ARON METERS, LTD., 72-82, Salusbury Road, London, N.W.6. The timer has a moulded plastic casing with dimensions 7½ in by 5½ in by 4½ in and a coin box which will take six permutations

of any two coins between a penny and a half-crown. Although intended primarily for television receiver rental, when it can be attached to the set or wall mounted, the timer can also be used with all other types of domestic electrical appliances which are hired out.

ADJUSTABLE PULSE SWITCH

The type I.P.D.1 switch introduced by HONEYWELL CONTROLS, LTD., Greenford, Middlesex, provides an electrical pulse of predetermined length and is designed for applications in which momentary opening and closing of a circuit is necessary. The pulse operation is accomplished by depressing an operating plunger which closes the contacts during a definite length of travel of the actuating rod.

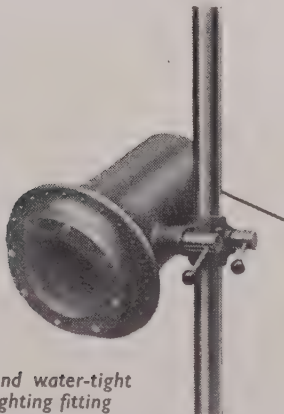
The pulse length is directly dependent on the speed of the external plunger motion. The length of plunger travel during which the pulse is produced can be varied from 0.03 to 0.45 in, beyond which the unit becomes a standard limit switch. The rating of the single-pole double-throw contact is 10 A at 125, 250 or 480 V a.c.; ½ A at 125 V or ¼ A at 250 V d.c.

TEMPORARY CONTINUITY CONNECTOR

A device for temporarily connecting armour wires or tapes, metallic sheathing or concentric neutral wires of electric cables whilst jointing on a live network is announced by the HEPWORTH IRON CO., LTD., 116, Canbury Park Road, Kingston-upon-Thames, Surrey. The connector comprises two nickel-plated bodies joined by heavy tinned copper braid housed in a thick transparent plastic sleeving. After passing the free end round the cable, the braid is hooked into a hinged claw fitting, pulled tight and secured by a screw on the far side of the body. Close contact is then established by tightening a second screw.

RESIN-CAST CURRENT TRANSFORMERS

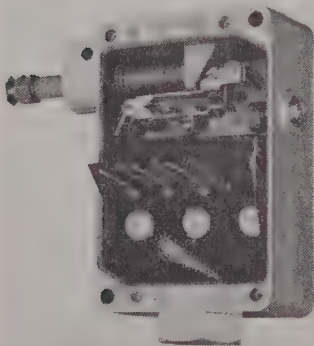
In the latest protected ring type current transformers produced by SMITH HOBSON, LTD., Hersham Trading Estate, Walton-on-Thames, Surrey, the complete unit is encapsulated in



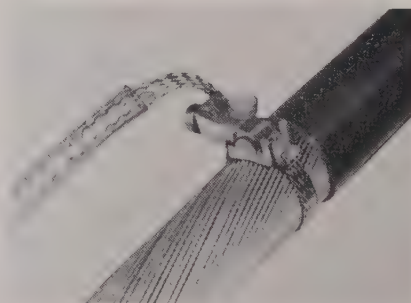
Allen dust- and water-tight television lighting fitting



Aron prepayment timer



Honeywell Controls adjustable pulse switch



Hepworth temporary continuity connector



Smith Hobson resin-cast current transformer units

resin, protecting the coil against moisture, temperature and mechanical damage. Single- or three-phase units are available with open or enclosed terminals. Busbars, with or without potential fuses, can be provided if required.

Units for currents between 100 and 2,000 A can be provided with VA ratings up to 15 except on the 100 and 150 A ranges where only 5 VA is available. Secondary currents can be 5, 1 or 0.5 A. The transformers are insulated for 660 V maximum at 50 or 60 c/s. Three inside diameters are available of 1½, 2½ or 3 in to suit the cable or busbar, and the maximum width of the unit is not greater than 3½ in.

PORTABLE TRIGGER GENERATOR

A portable pulse generator, type M.640, which is capable of delivering fast high-voltage triggering pulses from a low source impedance, has been developed by WINSTON ELECTRONICS, LTD., Shepperton, Middlesex. A feature is the negligible effect of load capacity on the rise time. Both positive and negative going pulses are available and there are facilities for synchronisation and triggering by an external signal, the available functions including free running operation, synchronisation of the free running condition, triggered operation with variation of the trigger level threshold and single cycle operation by push-button.

The pulse repetition frequency when free running is from 10 to 100,000 pulses/sec or with triggering operation from d.c. to 50,000 pulses/sec. The output voltage is continuously variable from 0 to 65 V and the maximum output impedance is 500 Ω. The output waveform is in the shape of a differentiated "spike" and the rise time is less than 0.15 μsec. The pulse width can be either 1, 10, 100 or 1,000 μsec.

External synchronisation can be from signals as low as ½ V peak amplitude having the same polarity as the required output pulse. The equipment may be operated from a separate

mains power unit or from the two 67.5 V dry batteries incorporated, the current drain varying from 1 to 10 mA depending on the setting of the p.r.f. control.

NON-CONTACT GAUGES

Several models of non-contact gauges produced by the American Daystrom company and utilising X-rays, infra-red rays and visible light for thickness or width measurement are now available from DAYSTROM, LTD., Gloucester. The "XactRAY" X-ray gauge consists of an X-ray generator, an incident unit or pick-up which converts the transmitted energy into an electrical signal and an elec-

tronic console which computes and converts the signal into meter indications. Dimensional changes are displayed as a deviation from the pre-set nominal thickness on an indicator calibrated in any unit of density or thickness.

A signal proportional to thickness deviation is available to operate automatic thickness control, data logging devices, strip chart recorders or for marking off-gauge material. The distance between the generator and pick-up unit can vary between 6 and 36 in. Metal standards can be inserted into the X-ray beam by rotary solenoids for calibration, the new thickness range being set in less than 10 sec including recalibration. The five models of the gauge give a range from 0.00035 in for aluminium foil to 2 in for steel plate. Each model has a thickness range up to 200:1. The accuracy can be up to 0.5 per cent.

FREQUENCY MEASURING EQUIPMENT

The frequency and time measuring equipment type TSA 3336, developed by VENNER ELECTRONICS, LTD., Kingston By-Pass, New Malden, Surrey, has provision for measurement of

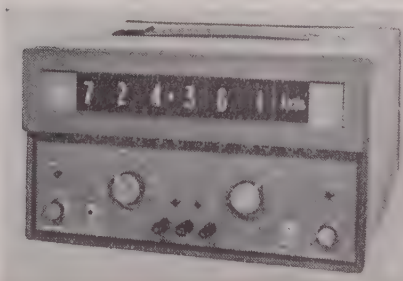


Typical installation of a Daystrom "XactRAY" X-ray non-contact thickness gauge



Winston Electronics portable pulse generator

Venner type TSA 3336 frequency and time measuring equipment



frequency (events per unit time up to 1.1 Mc/s), inverse frequency (period), simple counting and time intervals in microseconds or larger units. In addition the outputs of the oven-controlled megacycle crystal oscillator and the decade divider chain are made available for external use as "clock" pulses. The instrument may be reset remotely, or locally by manual or automatic operation.

The equipment includes transistor plug-in circuit modules and can be supplied with outputs to operate a printer or a re-perforator. It measures 14½in by 12¾in and 8½in high and weighs 26 lb. It can be operated from 100-125 V, 200-250 V, 50 c/s mains or 12 V d.c. The price in the United Kingdom only is £338.

MINIATURE PRECISION RESISTORS

Precision wirewound fixed resistors known as the "P" type, in fifteen standard sizes including three printed circuit models, have been included in a range of products manufactured by MINIATURE ELECTRONIC COMPONENTS, LTD., The Lye, St. Johns, Woking, Surrey. These resistors are wound on bobbins made from mineral-filled epoxy resin and then enveloped with the same hot-curing resin. Connection is made through axial wire leads or radial lugs and the contours of the resistor body are planned to provide a long leakage path between terminals or to earth. The terminal anchorage is designed so that excessive flexing of the lug or lead cannot destroy the seal.

INDUSTRIAL PROJECTION TUBE

A high brightness 5in diameter industrial projection tube intended for applications where large screen displays are required is now being marketed by MULLARD, LTD., Mullard House, Torrington Place, London, W.C.1. The type MW13-38 tube has a light output of 970 mk/cm² (2,813ft-lamberts) at an anode voltage of 50 kV and this makes possible, using a suitable optical system, an optical magnification of 40 times. Thus, with a raster size of 72 by 96 mm, displays of up to 12½ft high can be shown.

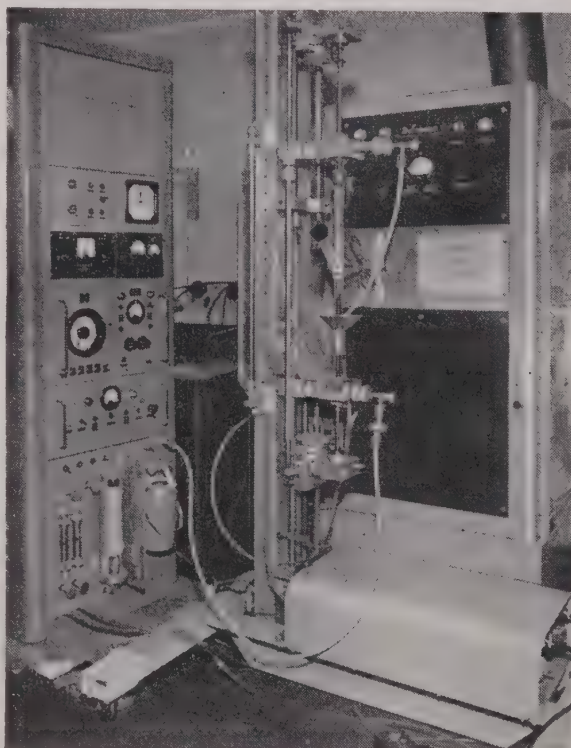
Magnetic focusing and magnetic deflection are used and the tube is manufactured from a non-polarising glass to prevent the screen blackening. Typical operating conditions are an anode voltage of 50 kV and peak current of 2.5 mA. At an average current of 500 µA, the resolution is better than 625 lines. An internal spark trap is incorporated to prevent internal flashover between anode and grid.

ZONE REFINING INDUCTION HEATER

A new induction heating r.f. generator, model EgZS, developed for semiconductor crystal growing and zone refining at the Royal Radar Establishment, Malvern, is now being produced by DELAPENA & SON, LTD., Tewkesbury Road, Cheltenham, Glos. This induction heater has a continuous power output to B.S. 1799:1952 of 9 kW and at this output the power input is 20 kVA at 0.85 power factor from a supply between 360 and 440 V. The operating frequency is between 4 and 5 Mc/s. For load matching internal boost condensers are fitted, adjusted for the particular application

being admitted through filter elements in the cabinet wall. In addition, the r.f. tank circuit, output transformer and work coil are water cooled, water normally being taken direct from the mains supply but water circulating equipment can be provided if required.

The external mains circuit-breaker is tripped should the access door be opened or the fan motor overloaded. A shorting bar connects the oscillator valve anode to earth when the door is opened. All main circuits are provided with h.r.c. fuses and the oscillator filament is given warm-up protection by a time-delay switch.



Delapena zone refining induction heater (Photo Crown Copyright)

and normally left permanently in circuit. Power control can be obtained by fitting a Variac variable transformer outside the generator, connected into the h.v. transformer primary leads.

The oil-immersed mains transformer is mounted in the lower part of the main cabinet with three English Electric mercury arc rectifier valves connected to give three-phase half-wave rectification. The r.f. circuits are housed in the upper part of the main cabinet and mains switchgear and auxiliaries are mounted on the inside of the access door. The oscillator valve is cooled by air blast from a motor driven fan, while the cabinet and other components are cooled by forced air circulation, air

Surge suppression is incorporated and the set is fully screened to prevent radio interference and suppressed to prevent r.f. feed-back into the mains supply.

For installation, a 360/440 V three-phase, 50 c/s, 30 A, three-wire-and-earth power supply and a cooling water supply of ½ gal/min at 40-60 p.s.i. must be available. In addition, a three-pole, 440 V, 60 A circuit-breaker with three 31.3 A overload coils and no-volt release is required. It should be fitted with a no-close hook so that the contacts cannot "make" momentarily if the no-volt circuit is open and the handle is closed. Two earth-closing insulated auxiliary switches, oil class B, to B.S.S. 148 should also be fitted.

TRENDS IN DOMESTIC APPLIANCE DELIVERIES

A NUMBER of conflicting trends are revealed in the figures issued by the B.E.A.M.A. of manufacturers' deliveries of domestic appliances in the fourth quarter of last year. In considering these figures it must be borne in mind that comparison is being made with the last months of 1959 when deliveries and sales were exceptionally large. Thus, deliveries of spin dryers, which in the fourth quarter were 44 per cent down on a year earlier, were still markedly higher than the level achieved in the previous quarters of last year. The figures issued by the Electricity Boards also show that though sales of refrigerators and washing machines were lower in 1960 than in 1959 they were well above the level for earlier years.

Again, although total home deliveries of washing machines were £2½ million less in the fourth quarter of 1960 than they had been a year earlier, this overall figure masks a gain of 16 per cent in machines incorporating a spin dryer and a fall of 61 per cent in those with hand or powered wringers. As shown in the accompanying graph, exports of models with spin drying facilities were continuing their upward trend at the end of the year, when they were 80 per cent higher than in the fourth quarter of 1959.

Other appliances where a gain in exports can be contrasted with a fall in home deliveries are vacuum cleaners, irons, food mixers, refrigerators and dry shavers.

The increasing popularity of electric cookers is reflected in an 11 per cent rise in deliveries compared with a year

ago. Electric water heating appliances (up by 29 per cent), space heaters (plus 35 per cent), and electric blankets (plus 30 per cent) also suggest an increasing public awareness of the advantages of modern electrical living.

Home deliveries of refrigerators were 53 per cent less in the fourth quarter of 1960 compared with a gain of 45 per cent in exports. But this very sharp decline in manufacturers' home deliveries would appear to be the culmination of troubles experienced during the summer when production was maintained at a fairly high level despite the slump in sales and the growth in stocks. It will be interesting to see whether the figures for the current quarter reveal that stocks have been reduced to a level sufficient to encourage retailers to start ordering again for the coming selling season.

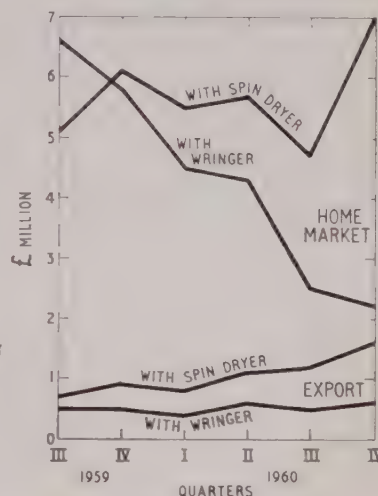
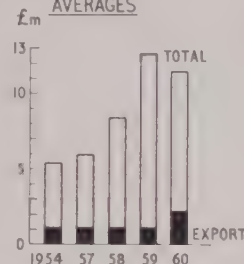
Refrigerators

According to the Domestic Refrigeration Development Committee the demand for domestic refrigerators has started slowly this year. Manu-

facturers' deliveries of domestic refrigerators to the home market during January totalled 43,144, a decline of 46.5 per cent on January last year, when deliveries reached 80,685. In issuing these figures the Committee

WASHING MACHINES

QUARTERLY AVERAGES



Comparison of the production and exports of the two main types of washing machine

points out that the extension of the hire-purchase repayment period is of little assistance in the sale of domestic appliances; the stimulus required is a reduction of the initial deposit from 20 to 10 per cent.

Exports of domestic refrigerators have maintained a satisfactory increase. Deliveries in January to overseas markets were 10,870, an increase of 58.6 per cent on January, 1960.

MANUFACTURERS' DELIVERIES OF DOMESTIC ELECTRICAL APPLIANCES FOR OCTOBER-DECEMBER, 1960

	HOME			EXPORT			TOTAL		
	Number 000s	£000	% Change on corresponding period of 1959	Number 000s	£000	% Change on corresponding period of 1959	Number 000s	£000	% Change on corresponding period of 1959
Washing machines with electrically driven means of agitation	62	2,239	-61	24.3	644.8	+22	86	2,884	-54
(a) those with hand or power wringers	114	7,039	+16	51.2	1,609.3	+80	165	8,648	+24
(b) those combined with a spin dryer	53	356	-19	0.9	6.5	+28	54	363	-18
Wash boilers (up to 10 gal) ...	65	931	-44	10.6	136.2	-19	76	1,067	-42
Spin dryers ...	14	424	-6	0.4	10.2	-63	14	434	-9
Heated tumbler dryers ...	40	27	-23	13.7	8.1	+16	54	35	-17
Irons (a) non-automatic ...	436	757	-14	193.7	293.4	+11	630	1,050	nil
(b) automatic ...	242	3,282	-33	77.3	626.7	+38	319	3,909	-27
Vacuum cleaners ...	6.2	83	-8	17.0	146.4	-9	23	229	-9
Floor polishers and scrubbers ...	59	n.a.	-53*	22.1	n.a.	+43	81	n.a.	-42
Electric refrigerators* ...	32	389	+39	1.9	16.2	+27	34	405	+38
Cookers (a) below 5 kW ...	144	5,137	+11	4.1	113.4	-9	148	5,250	+11
(b) 5 1/2 kW ...									
Food and drink mixers up to 3 quarts capacity including all hand held ...	45	499	nil	23.8	304.7	+39	69	804	+12
Toasters ...	54	165	-8	25.4	79.1	+10	79	244	-13
Water heaters									
(a) Immersion up to 3 kW ...	176	251	+29	3.0	6.1	-47	179	257	+24
(b) Storage up to 30 gal ...	46	491	+29	3.7	51.3	+4	50	542	+26
Space heaters up to 3 kW ...	1,192	4,704	+35	31.3	98.8	+7	1,223	4,803	+34
Electric blankets ...	521	1,490	+30	2.3	5.3	+26	523	1,495	+30
Hand hair dryers ...	196	355	-12	21.5	37.7	+91	218	393	-7
Dry shavers ...	404	1,379	-26	107.2	242.0	+323	511	1,621	-16

* Supplied by the Domestic Refrigeration Development Committee; percentage increases based on numbers.

n.a. = not available.

ELECTRICAL MANUFACTURE IN EUROPE

GROWING EFFICIENCY OF FRENCH

Expanding Output and Investment

By HENRI DAVEZAC*

LAST June, 78 years after the first international electrical exhibition organised in France, the French electrical industry put itself on show to the public in an exhibition in Paris called "ELECTRAMA." The occasion aroused great interest. It was attended by the Prime Minister, accompanied by all members of his Government concerned with economic questions; le Centre National des Industries et des Techniques (National Centre for Industry and Engineering) for the first time welcomed an industrial event designed to have a wide public appeal; and above all the thousands of visitors who came to the Rond Point de la Défense at Puteaux were made aware of the importance, variety and essential utility of the equipment on display. The exhibition also brought home to them the universal application of the products of the French elec-

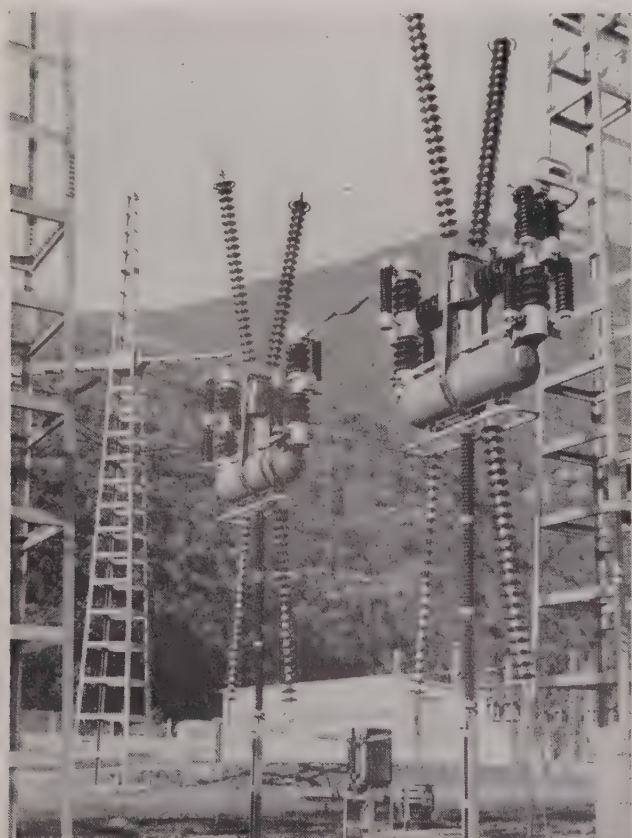
trical industry and the part it plays in the most widely varied activities of modern life. They were made to realise that in addition to its basic role as a producer and supplier of energy, the electrical industry is everywhere at work, driving, regulating, transmitting and controlling, and that there is not an aspect of technical progress to which it does not contribute to a greater or lesser degree.

The growing importance and universality of the French electrical industry is supported by the following facts:— Electrical and electronic engineering now occupies fifth place† among the industries of France; it comprises 1,831 companies‡ employing a total of 260,000 people, with a turnover, in 1959, of 9,600 million NF (new francs); the industry is sub-divided into 31 main branches, all of which belong to the Syndicat Général de la Construction Electrique (General Association of Electrical Industries). Table 1 shows how these branches developed between 1949 and 1959.

During these ten years, production in the industry as a whole increased by 173 per cent, but since the number employed rose by only 38 per cent, productivity has leapt forward by 111 per cent, which corresponds to an annual increase of 7.7 per cent. The annual rates at which production has increased in each of the main branches of the industry during this period may also be calculated from the table. For example, the average rate for the industry of +10.5 per cent per annum compares with: telephone and telegraph equipment (+4.2 per cent); electric wires and cables (+6 per cent); industrial equipment (+7.7 per cent); lighting equipment (+9.6 per cent); plastic and insulating material (+11 per cent); capacitors (+15 per cent); relays (+17 per cent); lifts and hoists (+18 per cent); domestic appliances (+20 per cent); electronic equipment (+25 per cent).

It will be seen from this list that while it took ten years for the output of equipment for industry to double, electronic equipment took only three years. This difference between "heavy current" and "light current" equipment is just as marked in their physical aspects as in their rates of development.

Industrial equipment, which covers everything needed for the generation, transmission, transformation, distribution and industrial utilisation of electric power, is the



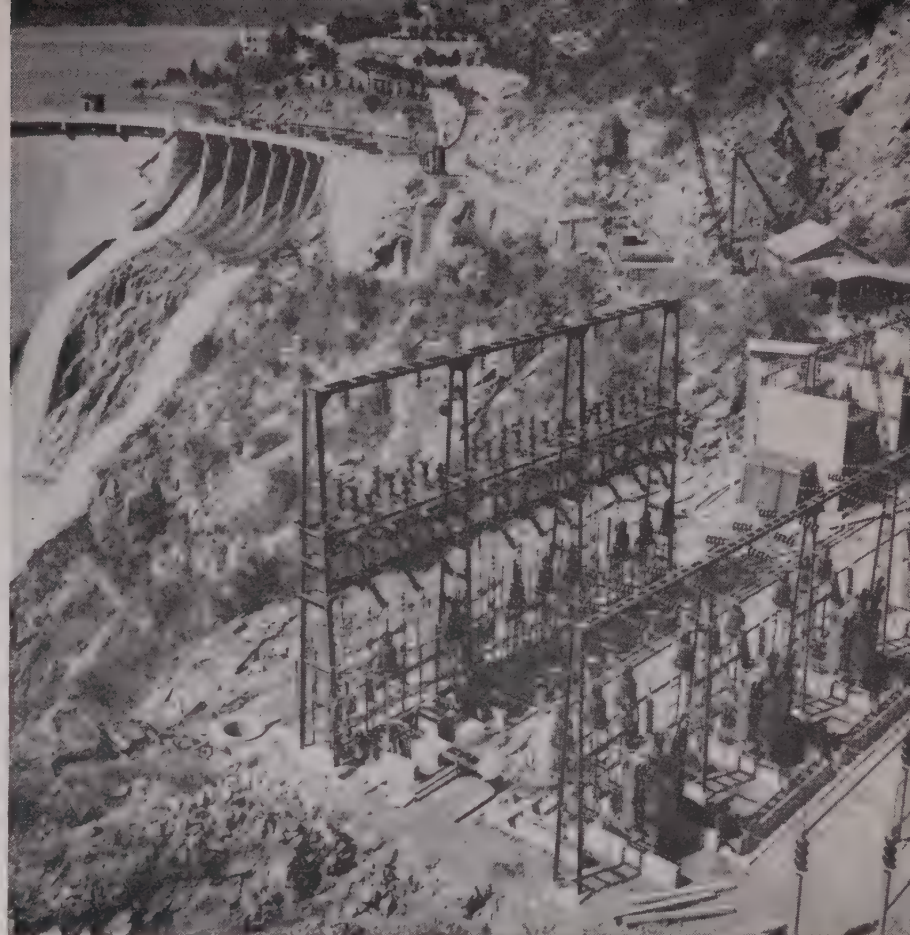
380 kV suspended air-blast circuit-breakers at d'Alberville, France. Nearly 2,000 km of the French grid has been equipped to work at 380 kV and 500 km of these lines are now operating at this voltage

* President, Syndicat Général de la Construction Electrique.

† After mechanical engineering and foodstuffs, textile and chemical industries, but ahead of the motor car and iron and steel industries.

‡ Excluding artisan-type firms with fewer than five wage earners.

Previous articles in this series were published on 17th February (West Germany) and 24th February (Belgium).



This hydro-electric station at La Vina, Argentina, is one of sixty power stations which French manufacturers have equipped since the war

INDUSTRY

The French electrical industry comprises nearly 2,000 firms with a total output of £685 million. Though exports account for only 10 per cent of this, imports of electrical equipment are also low at £31 million. During the past 10 years output has risen by 173 per cent and productivity has more than doubled

largest consumer of the 23,000 tons of cast iron, 180,000 tons of steel, 75,000 tons of copper, 6,700 tons of aluminium and 79,000 tons of lead purchased annually by the electrical industry.

On the other hand, the output of the electronics side of the industry—comprising radio and TV apparatus, industrial equipment, thermionic valves and components (Groups 18, 22, 23 and 24 in Table 1)—accounts for a relatively low consumption of raw materials. In this field, however, the products are of such complexity, and the

need for research so continuous, that the proportion of engineers and skilled personnel engaged in it is at times from 45 to 70 per cent of the total labour force.

This does not mean that there is not a constant need for more engineers for the production of heavy industrial equipment. A recent survey revealed that in 179 companies, typical of this branch, 881 engineers and skilled personnel, out of a total of 3,213, i.e. 27.42 per cent, were engaged in research.

The work carried out by manufacturers of industrial

TABLE 1.—PRODUCTION, EARNINGS AND EMPLOYMENT IN THE FRENCH ELECTRICAL INDUSTRY

Class of Equipment	Production Indices (Base 100 = 1956)		Turnover (million NF)		Numbers employed		Number of companies* as at 1.1.60
	1949	1959	1949	1959	1949	1959	
1. Rotating electrical machines	68.2	138.2	205.78	726.32	18,951	23,088	127
2. Static transformers and converters	58.7	124.3	147.51	444.81	14,019	11,495	107
3. Industrial electrical equipment	57.4	120.7	255.14	739.63	20,030	20,649	183
4. Installation equipment	53.8	125.7	62.12	227.07	6,661	7,973	121
5. Railway signalling equipment	99.8	79.2	26.72	42.31	2,988	2,209	15
6. Storage batteries, non-alkaline type	64.9	118.4	73.66	198.14	4,025	3,360	24
7. Small-scale rail and road traction	92.4	68.4	25.01	20.19	1,311	467	11
8. Fixed capacitors	39.5	166.6	21.78	118.83	2,095	4,177	44
9. Heating equipment and domestic appliances	22.0	150.8	95.64	1,013.82	8,826	20,263	220
10. Primary cells	40.7	130.0	23.31	141.63	2,225	4,585	8
11. Lifts and hoists	32.6	171.5	22.68	222.82	2,733	6,296	39
12. Radiological and electro-medical equipment	48.7	73.9	25.84	84.38	1,959	2,307	37
13. Meters, instrument transformers, electrical and electronic test and control gear	59.2	129.6	81.66	342.19	7,607	10,292	97
14. Insulators, mineral type	100.7	106.5	33.60	54.28	3,711	3,040	17
15. Lighting equipment	52.8	131.0	25.70	106.49	1,910	2,791	55
16. Electric lamps	58.1	122.3	107.64	285.60	8,691	8,994	56
17. Plastic and insulating products	52.4	150.5	73.98	320.12	6,900	9,971	171
18. Radio, television and sound reproducing equipment	24.3	162.7	110.59	960.51	10,303	14,515	131
19. Electric wires and cables	60.0	108.1	358.65	1,136.67	18,071	19,806	69
20. Telegraph, telephone and related equipment	71.9	108.2	142.05	505.89	15,860	20,229	66
21. Miscellaneous equipment	—	—	1.90	10.20	199	286	12
22. Radio and electronic components and accessories	18.6	147.9	29.09	412.82	4,700	13,365	175
23. Industrial electronic and radio equipment	32.3	105.7	75.88	668.50	8,212	22,700	69
24. Thermionic valves and semiconductor devices	25.0	186.7	42.86	338.38	5,018	9,723	17
25. Cases for low-voltage pocket-lamps	96.1	124.4	4.57	14.21	439	991	8
26. Electrical machine repairs	125.9	110.0	57.02	97.93	6,905	5,503	225
27. Conduits and ancillary equipment	100.2	97.1	10.56	18.22	587	678	16
28. Glass for electrical purposes	53.6	155.3	4.06	32.06	676	459	2
29. Storage batteries, alkaline type	79.3	90.1	21.13	45.31	747	1,406	4
30. Heavy traction equipment	31.9	146.6	11.50	176.01	1,378	6,538	9
31. Electrical relays	40.0	202.3	8.11	64.11	815	1,999	32
Total	47.2	128.7	2,185.86	9,579.45	188,552	260,155	1,831

* Companies employing over 5 persons.

equipment is very much in the national interest, since it governs the rate at which the use of energy grows in France. It has enabled total power consumption in the country to climb from 24,300 million kWh in 1946 to 53,000 million kWh in 1956, and to 62,000 million kWh in 1959.

The increasing demand for power has led to a corresponding development of the technical means of providing it. Thus, in the space of 20 years the size of turbo-alternators has risen from 50 to 250 MW, and the capacity of transformers from 60 to over 300 MVA. The 400 kV stage has been quickly passed, and 525 kV equipment is now being supplied for use abroad.

Circuit-breakers have undergone a similar development. Units for 400 kV were made as long ago as 1952, and 525 kV units, guaranteed for the enormous breaking capacity of 25,000 MVA, have already been delivered and will shortly be in service.

With rectifiers, the latest development has been the appearance of semiconductors. Finally, as is generally known, French locomotives hold the world speed record of 205 m.p.h., and in 15 years their weight/power ratio has been drastically reduced.

These technical improvements have, moreover, in many cases been accompanied by a reduction in cost. For example, between 1952 and 1959 manufacturers reduced the weight of 20 MVA transformers to a third of the original figure, the losses by 30 per cent, and the prices by 50 per cent. In the past 15 years the 220 kV three-phase circuit-breaker has been brought down in weight from 18 to eight tons, while its price has been reduced to an even greater degree. The 25 kV, 50 c/s system of electrification adopted by the S.N.C.F. (French National Railways) permits a saving of one-third to be made on fixed installations. It is now accepted throughout the world for new installations.

If the technical improvements made in industrial equipment appear to have been rapid, those achieved in the



This 1,500 V d.c. locomotive, which holds the world rail speed record of 205 m.p.h. is used regularly on the "Mistral," which covers the 320 miles between Paris and Lyon at an average speed of 80 m.p.h.

field of electronics have been even more remarkable. In fact, of the equipment which is being manufactured today, 70 per cent had not passed beyond the laboratory stage five years ago, and this rapid development is continuing.

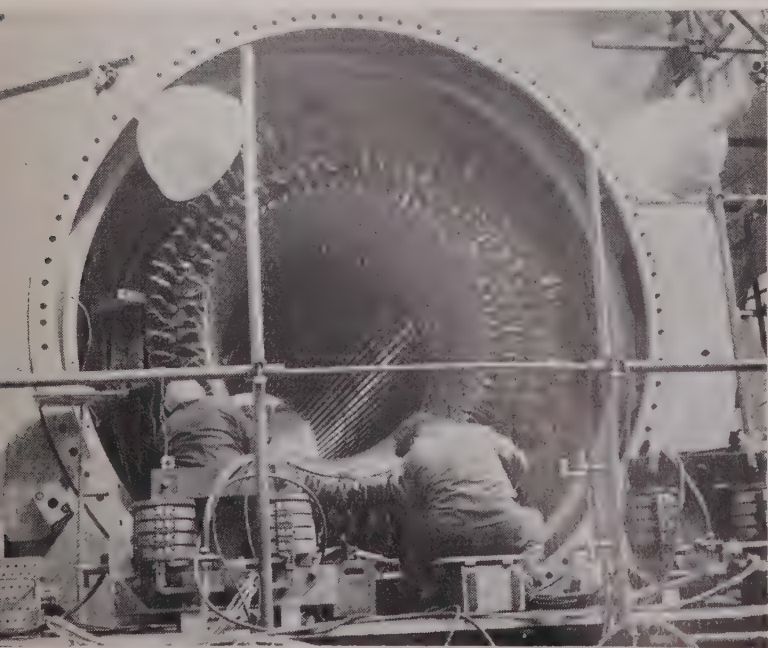
Among the more recent examples of progress in this field, mention should be made of the great advances in the propagation of radio waves, the utilisation of decimetric, centimetric and millimetric waves, the increase in the output of transmitters, and the improved design of thermionic valves. Thanks to electronic devices, such as storage units and computers, automation has also made rapid strides.

Finally, with high-frequency induction furnaces and "plasma" phenomena, electronics has established itself in the field of power engineering. The direct conversion of thermal into electrical energy, of the calorie into an electric charge, and the universal applications associated with such a discovery, now appear to be possible.

All this technical achievement is the work of men, and in the next ten years the French electrical industry will have to recruit 200,000 new workers. Exceptionally heavy capital expenditure is involved, since, to the normal industrial outlay, must be added all the costs of research specific to this industry.

The money invested by the industrial equipment side of the industry since 1953 represents between 4 and 5 per cent of turnover. During the past year investment was distributed as shown in Table 2.

The proportion of investment on the electronics side of the industry is even higher, having risen to 6 per cent of a turnover which has increased in the following stages: 1,150 million NF in 1955; 1,450 million NF in 1956; 1,850 million NF in 1957; 2,100 million NF in 1958; and 2,600 million NF in 1959.



A 250 MW turbo-alternator under construction in a French factory

Table 2.—Gross Investment in Capital Equipment

Class of equipment*	Investment in 1959 in million NF	Percentage change 1959/1958	Investment 1959 per wage earner NF	as a percentage of turnover
1	40.2	+25.1	1,741	5.5
2	18.4	+10.4	1,600	4.1
3	28.7	+7.7	1,390	3.9
5	2.8	-13.7	1,250	6.5
7	0.6	-6.6	1,360	3.1
30	9.8	+24.4	1,496	5.6
31	1.9	+23.3	950	3.0
Total ...	102.4	+15.4	1,541	4.6
Total for all electrical industry	390.4	+7.6	1,500	4.1

* Figures relate to specific equipment, the designation of which is given in Table 1.

In view of its importance to the economic life of the country, and its defence, the electrical and electronic equipment made in France is required, to a large extent, for nationalised undertakings in the public sector. Thus, for example, in 1959, out of a total sales figure of 9,579 million NF, the public sector accounted for 2,892 million NF, i.e. 30.2 per cent, made up as follows:—Electricité de France and nuclear energy (1,091 million NF); national defence (490 million NF); postal, telephone and telegraph services (485 million NF); French National Railways (322 million NF); nationalised mines (157 million NF); national broadcasting system (141 million NF); municipal undertakings (102 million NF); public works (56 million NF); and health services (48 million NF).

In the private industrial sector, which in 1959 placed orders for 1,484 million NF, i.e. 15.5 per cent of the total, mechanical engineering heads the list with 755 million NF, followed by miscellaneous industries (265

million NF), mines and the iron and steel industry (246 million NF), factory installations (128 million NF), and professional users (90 million NF).

The general public purchased goods to a value of 1,986 million NF, and contractor-retailers in both the public and private industrial sectors spent 273 million NF. Finally, deliveries within the electrical industry itself amounted to 1,026 million NF. The remaining 10.5 per cent, i.e. 1,008 million NF, is accounted for by exports, of which 57.8 per cent (583 million NF) went to foreign countries and 42.2 per cent (425 million NF) to the former French Overseas Territories.

The electrical industry has a very favourable trade balance, total imports of electrical equipment amounting last year to only 423.7 million NF. Moreover, exports of the products of the industry as a whole, and more particularly of industrial and electronic equipment (250 million and 340 million NF, respectively, in 1959), have enabled over 80 countries to form an estimate of the quality and merits of French engineering.

Among the various customers, a special place must, of course, be set aside for the other five members of the European Economic Community. They have taken up 31.4 per cent of the total exports of the French electrical industry which, in turn, has obtained 37.8 per cent of its imports from the Common Market. This flow of trade, already considerable, will undoubtedly expand still further if agreement is reached on the unification of manufacturing standards between member countries. Discussions on this subject are now taking place and it is too soon to say to what results they may lead.

NEW BOOKS

Magnetic Materials in the Electrical Industry. By P. R. Bardell. Second Edition. Pp. 320; figs. MacDonald & Co. (Publishers), Ltd., 16, Maddox Street, London, W.1. Price 32s 6d.

The author's aims, in bridging the gap between theoretical treatises and handbooks for the practical engineer, are entirely praiseworthy. It is surprising how many fundamental works on magnetism, even from eminent authors, can convey by omission or by inappropriate reference, misleading ideas about the significance of practical aspects; on the other hand, compilations for engineers are notorious for the inaccuracy of information provided on highly specialised subjects.

Mr. Bardell's objective has been well achieved, and the new edition of this book is therefore welcome, as it brings up to date and supplements, still in a volume of manageable proportions, very extensive and authoritative information on both theoretical and practical aspects. The chapter on new applications of ferrites, and the extension to the chapter on magnetic recording, are valuable additions.

One of the numerous difficulties involved in the preparation of such a book, which has perhaps not been resolved with complete success, is the arrangement of the presentation of data on properties and applications. The author has adopted a mixed category of headings, covering sometimes materials and sometimes applications.

The inherent danger of duplication has been commendably avoided, but as a result it is not always easy to locate particular detailed information required. Thus, for use as a reference book, it would have been helpful to have included a more detailed index and additional cross references.

A power engineer might criticise the fact that relatively little space is given to applications in his field, which in fact consume a far larger tonnage of magnetic materials than all other users put together. It is clearly shown, however, that other applications make use of a far wider range of materials, involving more detailed and complicated technical considerations; these have been given full justice.

For advanced students and other readers with general interests, the treatment is excellent; it is well assisted by a pleasant and straightforward style of writing, together with copious illustrations, diagrams, and tables of properties.—C.J.S.

Books Received

Electrical Theory on the Giorgi System. By P. Cornelius. Pp. 187; figs. Cleaver-Hume Press, Ltd., 31, Wright's Lane, Kensington, London, W.8. Price 32s.

Keith in Electricity. By Norman Longmate. (A career book for boys.) Pp. 144. Chatto & Windus, 40-42, William IV Street, London, W.C.2. Price 8s 6d.

Financial Section

STOCKS and SHARES

A VERY marked improvement in the investment demand for the shares of the major electrical groups followed publication of Lord Nelson's review in the English Electric Company's annual report and news of the General Electric Company's offer to acquire the share capital of Radio & Allied Holdings (the "Sobell" and "McMichael" company). The latter announcement included the information that interests representing some 65 per cent of the ordinary and convertible shares of the radio company had already agreed to accept the offer of one £1 G.E.C. share, plus 2s cash, for every R. & A. 5s share. These terms lifted the price of the latter to about 37s, as compared with little more than 20s a month previously, so that apart from other considerations the remaining shareholders are not expected to hesitate in accepting their directors' strong recommendation to agree: Mr. M. Sobell and Mr. Weinstock, of R. & A., are to join the board of G.E.C. on the implementation of the merger.

Dividend Prospects

With their last respective interim dividend declarations, G.E.C. estimated that the current year's profits would be somewhat below the previous figures, and Radio & Allied envisaged appreciably lower earnings. The G.E.C. directors intend to maintain the ordinary dividend at 10 per cent. R. & A. shareholders would receive a second interim payment making a total of 30 per cent for 1960-61, so that on the basis of these rates their income would be increased by one-third as a result of the share exchange. This early and important manifestation of the G.E.C. group's recently declared intention to improve organisation and strengthen management was followed by a rise of as much as 5s 9d in the price of the £1 shares, to 37s. News of the German currency revaluation was interpreted as being favourable to electrical engineering investments in general.

English Electric

At 40s 9d the £1 shares of English Electric showed an improvement of 7s over the week. As already known from

the preliminary statement on the results for 1960, the net group profit of £3.1 million was just about level with the previous year's, despite losses by the Marconi Italiana, D. Napier and Canadian subsidiaries. These offset the substantially better results achieved

by the parent company and some of its other subsidiaries. While the output of the English Electric group is said by the chairman to have been much the same as in 1959, the booking of a record volume of orders during the year gave good hopes of increased

Price Changes in

Company or Board	Nom. Value	Middle Rise price 6th Mar. Fall	Week's		Dividend	Yield %	1960	
			Pre-	Last			High-	Low-
			vious				est	est
<i>Gilt-edged Stocks</i>								
						£ s d		
Brit. Elec. 1968/73	100	74½ x.d. —½	3	3		4 0 6	79½	74
Brit. Elec. 1974/77	100	70	3	3		4 5 9	76	69
Brit. Elec. 1976/79	100	73½ +½	3½	3½		4 15 3	79½	72½
Brit. Elec. 1974/79	100	80½	4½	4½		5 5 6	90½	81
Brit. Elec. 1967/69	100	91	4½	4½		4 19 0	97½	90
<i>Overseas Electric Supply</i>								
Calcutta Elec.	£1	21/-	7†	7½†		11 14 0	21/-	19/3
East African Power	£1	15/-	+1/-	8	10	13 6 9	20/3	13/-
Nigerian Elec.	£1	18/-		8	10	11 2 6	19/9	15/6
Perak Hydro-Elec.	£1	18/9	+9d	10	10	10 13 6	21/-	15/3
<i>Electrical Shares</i>								
Aberdare Holdings	5/-	15/3	17½	17½		5 14 9	19/-	14/6
Aerialite	1/-	7/3 +3d	54	54		7 9 0	9/6	6/3
Allen, W. H.	£1	38/9	14	10*‡		5 3 3	43/9	34/6
Allied Insulators	5/-	9/3 x.d. —3d	20	10*		5 8 0	11/6	9/-
Alwyn Holdings	5/-	25/9 —6d	—	12½		2 8 6	30/6	17/9
Anglo-Portuguese Tel.	£1	21/-	9	9		8 11 6	29/-	22/6
Arcoelectric	1/-	4/3 +3d	15	15		3 10 6	5/6	3/9
Aron Meters	£1	68/-	15	15		4 8 3	90/-	47/-
Assoc. Elec. Ind. Ord.	£1	46/3 +4/-	15	15		6 9 9	66/6	39/6
Automatic Tel. & El.	5/-	16/9 —3d	17	17		5 1 6	21/9	14/6
Babcock & Wilcox	£1	33/9	13	9		5 6 9	48/9	32/6
Bakelite	10/-	53/9 +3/9	15	17½		2 14 9*	52/-	33/6
Baldwin, H. J.	2/-	1/6	20	—		—	2/6	1/9
Berry's Electric	5/-	45/- +2/-	30	30*‡		3 6 9	38/6	22/3
Bowthorpe Holdings	2/-	8/6	27	18½*		4 7 0	11/6	7/9
Brit. Elec. Resistance	2/-	6/9	17½	17½*‡		5 3 9	8/3	4/6
Brit. Elec. Traction:								
Def. Ord. "A"	5/-	51/- +1/-	35	40		3 18 6	49/3	42/-
Brit. Electronic Ind.	5/-	13/6	—	15½		5 11 0	—	—
B.I. Callender's	£1	57/6 +1/6	13½	13½		4 13 9	61/-	47/9
B.I. Callender's 6% Pref.	£1	17/6 —6d	6	6		6 17 3	21/-	18/6
British Thermostat	5/-	38/9 —1/3	35	20*		2 11 6	32/6	21/3
Brook Motors	10/-	49/-	25	25*		5 2 0	53/6	43/9
Bulgin, A. F.	1/-	9/3	50	55		3 19 0*	10/3	8/-
Bulpitts	5/-	18/-	15	16½		4 10 3	23/3	16/6
Burco Dean	5/-	9/3 —3d	18	15		8 2 3	15/9	8/9
Cable & Wireless	5/-	19/6 +3d	10	10*		2 11 3	18/3	14/3
Cambridge Instruments	5/-	35/- +1/3	12½†	22		3 2 9	33/-	24/9
Chloride El. Storage "A"	£1	86/3	20	17½*		4 1 3	81/-	65/6
Clarke Chapman	£1	45/-	13½	13½		6 2 3	63/9	45/-
Combined Elec. Mfrs.	4/-	7/9	—	12½†		6 9 0	8/6	8/-
Contact Switchgear	5/-	15/-	14	14		4 13 3	17/9	14/6
Cossor, A. C.	5/-	7/3 +3d	5	Nil		—	10/-	5/-
Crabtree	10/-	30/9 —3d	20	12½*		4 1 3	39/6	24/-
Crompton Parkinson	5/-	13/6 +9d	14	12½*		4 12 6	15/-	10/9
Davis & Timmins	5/-	34/9 —6d	20*	30‡		4 6 3	35/-	17/-
De La Rue	10/-	63/9 +2/6	22½	22½†		3 10 6	78/6	47/9
Decca "A"	10/-	60/6 +6d	20	23½		3 17 0	51/3	40/9
Desoutter	5/-	51/3	21½	30		2 18 6	50/-	37/6
Dewhurst	2/-	9/9 +3d	20	20		4 2 0	8/6	7/-
Dictograph Tel.	2/-	11/9 +3d	20	20*		3 8 0	9/9	7/9
Dimplex	5/-	65/-	—	30		1 18 6*	48/-	22/6
Dubilier Condenser	1/-	2/9	25	30		5 9 0*	3/3	2/3
Duport	5/-	15/- +6d	17½	20		4 8 9*	20/-	12/9
E.M.I.	10/-	47/3 +1/-	20	17½*		3 14 0	58/9	41/9
Eleco	2/-	6/6	20	20		3 1 6*	4/6	2/6
Electrical Apparatus	5/-	17/6	14½	20		5 14 3	18/3	12/9
Electrical Components	5/-	9/6 +3d	15	11½*		6 1 0	13/9	9/6
Elec. Construction	£1	33/6	9	9		5 7 6	43/-	31/3
Elliott-Automation	5/-	29/-	9.3	12‡		2 1 6	36/-	19/9
Enfield Rolling Mills	£1	46/3 +9d	15	15		6 9 9	56/-	45/6

The above quotations are based upon middle prices in the Stock Exchange Daily Official List.

* After scrip issue. † Free of income tax. ‡ Dividend indicated.

output in 1961. His comments on the subsidiaries which made losses last year gave the impression that better things could be expected in the future, so that the market is encouraged to envisage for the present year a widening of the present rather narrow margin

between earnings and the amount distributed in dividend.

Firm Markets

Most sections of the industrial market remained active and buoyant during the week. Among electrical

shares there was an improvement of 4s to 46s 3d in A.E.I., on which the final dividend declaration and preliminary profits statement were expected yesterday (Thursday), and the rise in Crompton Parkinson continued up to 13s 6d. In the cable and telephone group, B.I.C.C. hardened to 57s 6d, while Johnson & Phillips and Ericssons again received favourable attention. I.C.T. added another 8s 9d to previous gains, reaching 86s 3d; the upward trend in Decca, Thorn Electrical, E.M.I. and Ultra Electric was also well maintained. Further advances in Allen West, A. H. Hunt, Strand Electric, Berry's and Simon Engineering were noticeable among numerous others.

Clifford & Snell

There has been a good demand for the 1s ordinary shares of Clifford & Snell since their introduction to the market last week. Early transactions took place at prices up to 2s 6d, at which level they offer a yield of around 4½ per cent on the basis of the 12 per cent dividend which the directors envisage for the present year. Profits have established a broadly upward trend in the past decade, and are expected to be in excess of £57,000 in 1961. This figure would provide two-fold cover for the indicated rate of dividend on capital of £184,300.

Colvern

An improvement equivalent to more than 10s in the price of Colvern 5s shares since the beginning of the year has been one of the best of recent performances in the electrical market. A one-for-two scrip issue was distributed last month and the shares have lately been quoted at about 48s in their "ex-bonus" form. For 1959-60 there was a well covered dividend of 35 per cent, the equivalent of which on the increased capital would be 23½ per cent. The directors are, however, expecting increased earnings this year, and there are hopes of a final dividend of 25 per cent, the same rate as was paid previously on the smaller capital.

Company News

Cambridge Instruments 5s shares were marked up further to 35s on the declaration of a final dividend making a total of 22 per cent for the year. Allied Insulators have been quoted a few pence lower at 9s 3d, x.d., since the dividend announcement: allowing for the intervening scrip issue, the 10 per cent total is effectively the same as for 1959. The 10s shares of Telegraph Condenser were little changed after the news of some contraction in trading profits and a fractionally lower distribution (also allowing for a scrip issue).

Electrical Investments

Company or Board	Nom. Value	Middle price 6th Mar.	Week's Rise or Fall	Dividend		Yield %	1960		
				Pre- vious	Last		High- est	Low- est	
Electrical Shares—continued							£	s	d
English Electric ...	£1	40/9	+7/-	10	10	4 18 3	53/-	29/6	
English Electric 3½% Pref. ...	£1	11/-		3½	3½	6 16 6	13/-	11/-	
Ericsson Tel. ...	5/-	26/9	+1/3	13½	13½	3 19 6	28/6	20/6	
Ever Ready ...	5/-	34/9	+9d	27½	20*	2 17 6	34/6	23/-	
Falk Stadelmann ...	£1	24/-	—9d	10	7½	6 5 0	35/9	22/6	
G.E.C. ...	£1	37/-	+5/9	10	10	5 8 0	47/6	29/6	
G.E.C. 6½% Pref. ...	£1	18/-	—3d	6½	6½	7 4 6	22/3	19/6	
General Cables ...	5/-	4/6	+3d	15	Nil	—	10/-	4/9	
Goblin (B.V.C.) ...	5/-	6/-		12½	10	8 6 9	13/9	6/-	
Hackbridge Holdings ...	5/-	6/-	+3d	20	20	8 6 9*	8/9	5/9	
Harland Engineering ...	5/-	18/6		14	16*	4 6 6	16/3	13/-	
Head Wrightson ...	5/-	23/9	+9d	20	14*	2 19 0	31/6	20/6	
Heatrae ...	2/-	13/9		20	22½	3 5 6	13/-	8/9	
Holophane ...	5/-	18/9		26	30	8 0 0	20/6	16/-	
Hoover ...	5/-	50/-x.d.	+1/6	90	45*	4 10 0	55/-	39/6	
Hunt, A. H. ...	4/-	24/9	+1/-	15	20	3 4 9	24/6	16/9	
Intl. Combustion ...	5/-	30/6	+6d	30	30	4 18 3	46/9	23/3	
Intl. Computers & T. ...	£1	86/3	+8/9	10	11½	2 12 3	78/6	58/9	
Johnson & Phillips ...	£1	22/9	+1/3	5	Nil	—	24/-	16/9	
Kenwood Mfg. ...	1/-	5/6		—	—	—	12/-	3/9	
Laurence Scott ...	5/-	17/9	+9d	15	15*	4 4 6	25/3	15/9	
Lister, R. A. ...	£1	54/-		14	14	5 3 9	62/-	52/-	
Lucas, J. ...	£1	64/6	—1/-	12½	13½	4 5 3	74/6	58/9	
Marryat & Scott ...	2/-	15/3		22½	27½	3 12 3	16/9	13/6	
Mather & Platt ...	£1	49/3		11	11	4 9 6	59/-	42/6	
Metal Industries ...	£1	64/3		14	15	4 13 6	76/3	52/6	
Midland Elec. Mfg. ...	£1	58/9x.d.		12	12	4 1 9	61/-	53/6	
Murex ...	£1	42/9	+9d	15	20	5 7 0*	45/-	35/6	
Newman Ind. ...	2/-	5/6		12½	12½	4 11 0	5/3	4/-	
Oldham & Son ...	1/-	3/-		17½	17½**	5 10 0	3/-	1/9	
Parsons, C. A. ...	£1	52/-	+1/6	8½	9½	3 12 0	59/-	44/-	
Philips' Lamps ...	Fl.10	235/-	+5/-	13-3	17	1 9 0	£12½	137/-	
Plessey ...	10/-	52/9	+9d	15½	17½	3 9 6	60/-	43/9	
Pullin, R. B. ...	2/-	12/-		25	25	4 3 3	14/3	10/-	
Pyrotex ...	5/-	52/6		34	40	3 16 3	56/-	44/3	
Radiation ...	£1	34/3	—1/-	6	12	7 0 0	44/6	28/-	
Reliance-Clifton ...	5/-	24/6		15	15	3 1 3	28/-	22/-	
Reyrolle ...	£1	43/9	+1/9	17½	17½	4 0 0*	52/3	33/9	
Richardsons Westgarth ...	10/-	6/6		8½	8½	—	14/9	6/3	
Sangamo Weston ...	10/-	28/-	+6d	12½	11*	3 18 6	27/-	19/3	
Scott, James ...	5/-	25/9		24	25*	4 17 0	34/6	27/6	
Simon Engineering ...	5/-	36/3	+2/3	—	26-6½	3 15 6	33/-	28/-	
Smith (England), S. ...	4/-	19/6		17½	20	4 2 0	20/-	15/6	
Southern Areas ...	£1	17/6	+6d	Nil	5	5 14 3	16/-	13/-	
Strand Elec. ...	5/-	17/-	+2/3	20	14-6*	4 6 0	14/-	10/6	
Sturtevant ...	5/-	15/6		15½	15½	7 19 0	24/3	13/-	
Sun Elec. ...	5/-	17/-		15	18½	5 8 9	17/6	15/-	
T.C.C. ...	10/-	41/-		35	22½*	5 9 9	48/3	37/3	
Telephone Rentals ...	5/-	25/-		12½	15*	3 0 0	24/-	17/-	
Thompson (John) ...	5/-	15/3		25	20	6 11 3	25/9	14/6	
Thorn Elec. ...	5/-	57/-	+4/-	20	25	2 3 9	55/6	44/3	
Thornycroft ...	£1	30/-	—1/6	6	6	4 0 0	31/-	20/3	
Tube Investments... ..	£1	80/-	+6/6	—	14	3 10 0	95/6	65/3	
Ultra Electric ...	5/-	19/3	+1/3	20	25	6 9 9	29/-	12/-	
Walsall Conduits ...	4/-	12/3		22½	15*	4 18 0	16/-	10/9	
Ward & Goldstone ...	5/-	29/-	—3d	30	35	3 0 3*	31/3	25/6	
Watford ...	2/-	10/9	+9d	25	25	3 14 6*	14/-	7/6	
Westinghouse ...	£1	40/6		11	11	5 8 6	59/9	38/9	
West, Allen ...	5/-	13/3	+9d	12½	12½*	4 14 3	17/-	11/-	
Wilkins & Mitchell ...	5/-	13/9	+6d	17	21*	—	25/9	13/6	
Wolf Electric ...	5/-	16/-	+3d	10	12½	3 18 3	14/9	10/9	

REPORTS and DIVIDENDS

G.E.C. Bid for "R. & A."—The General Electric Co., Ltd., as briefly reported last week, has made an offer to acquire all the share capital of Radio & Allied (Holdings), Ltd., manufacturers of Sobel and McMichael T.V. and radio receivers. The offer is worth £8.5 million. Some 65 per cent of the total voting power in Radio & Allied is already committed in favour of the deal, and the Radio & Allied directors "strongly recommend" the remaining shareholders to accept.

The G.E.C. offer is:—In exchange for each of the 1.8 million 5s ordinary and 3.2 million 5s convertible ordinary in Radio & Allied, one fully-paid G.E.C. £1 ordinary plus 2s in cash. For each 6 per cent £1 cumulative preference share in Radio & Allied, G.E.C. offers 20s cash.

The directors of both companies are confident that the new arrangements will result in the efficient deployment of their combined resources and will provide the basis for an expanding trade in both the home and export markets.

The offer will be conditional on G.E.C. holders agreeing to create the ordinary shares required to implement the offer and on permission to deal and quotation on the Stock Exchange.

As already foreshadowed, the boards of G.E.C. and R. & A. expect that the profits of their companies for the financial years ending respectively 31st March and 30th April, 1961, will be lower than the corresponding figures for the preceding year. The G.E.C. board intends to maintain the ordinary dividend for the year at the previous rate of 10 per cent and on the merger becoming effective they will, in order to simplify the merger arrangements, declare in lieu of the final dividend normally payable in September a second interim dividend of 7 per cent, less tax, which will be payable on 1st June, 1961.

To maintain the income of the ordinary shareholders of Radio & Allied during the transitional period its board will be invited to declare, in lieu of a final dividend in respect of the year ending 30th April, 1961, a second interim dividend of 22½ per cent, less tax, payable on 1st June, 1961, on the 1,800,000 issued ordinary shares. Accepting ordinary shareholders of Radio & Allied will retain their right to receive this dividend. No dividend will be paid in respect of the year ending 30th April, 1961, on the convertible ordinary shares.

On the offer becoming uncondi-

tional, Mr. M. Sobell (chairman of Radio & Allied) and Mr. A. Weinstock (managing director) will join the board of G.E.C. and Mr. A. Weinstock will assume the management of the radio, television and domestic equipment activities of the combined undertaking, with Mr. Charles Richards as his joint managing director.

The G.E.C. stated that the two companies accounted for 15 per cent of the radio and T.V. market and added that "the combined production and marketing facilities of both firms will help to bring popular colour T.V. nearer and will put the new group in a specially favourable position."

Hoover Prospects More Favourable.—In his review for 1960, Mr. H. W. Hoover, chairman of Hoover, Ltd., says that the domestic appliance industry is probably more closely linked to changing economic conditions than most and, unless these improve, it is difficult to foresee a real recovery from the present reduced volume of output. The recent change in the hire-purchase repayment period from two to three years is unlikely to have more than a marginal effect in stimulating sales.

However, being broadly based and, with the advent of the new products, Hoover are "in a more favourable position to overcome the problems of 1961."

Sales were maintained in the first quarter of the year, but the company were then already engaged in a planned reduction of output to meet an anticipated lower level of demand. Following the reimposition of hire-purchase restrictions at the end of April, sales in the last nine months fell by 33½ per cent compared with the corresponding period of 1959.

Earnings in the first quarter contributed very largely to the overall group profit which, at £6,372,783, was the second best on record, and without the past development of overseas business the effect of the sharp contraction in home demand would have been even more serious. Export sales last year rose by 37 per cent and the company were responsible for 75 per cent of U.K. exports of washing machines and vacuum cleaners.

It cannot be impressed on the Government "too strongly, that our continuing success in export markets is dependent upon the cost advantages which accrue from a stable flow of production." The belief that a restricted home demand will force manufacturers to divert their output to

overseas markets "is both erroneous and dangerous." Export markets can only be developed by unremitting effort over a long period, backed by highly competitive prices and by a constant process of product evolution dictated by the requirements of each market.

It is with such facts in mind that Hoover have urged upon the Government during the year the adoption, in consultation with industry, of a long-term credit policy, which would stabilise the amount of deposit and the period of repayment for a specific number of years.

In September, a Hoover refrigerator was launched on the Australian market. A new company, the Hoover Worldwide Corporation, to which the British group have contributed a 40 per cent share, has been formed, to study the growing markets for domestic appliances in under-developed countries, and to act in an advisory capacity in planning future policy and the deployment of resources to the best advantage.

As previously reported, the group net profit amounted to £3,520,965, against £5,485,662, and the dividend is effectively maintained at 45 per cent.

Cambridge Instrument Co., Ltd.—The dividend for 1960 is being raised from the equivalent of 20.41 to 22 per cent, less tax, on a capital increased by an acquisition, with a final dividend of 6 per cent. The 1959 total was 12½ per cent, tax free. An unchanged 4 per cent interim, less tax, is also declared for 1961.

Net profits of £283,592 compare with £256,965 after tax of £243,604 (£212,925). Due to the short period between the date of the merger with Electronic Instruments, Ltd., and the end of the financial year of that company the acquisition has had little effect on the profits, state the directors.

Thomas Bolton & Sons, Ltd., are raising their distribution from 10 per cent to 12½ per cent for 1960 by adding a 2½ per cent bonus to an unchanged final dividend of 7½ per cent. Trading profit, etc., increased to £448,067 from £286,690 and the net profit is up to £195,388 from £92,993 after tax of £101,813 (£82,302) and depreciation £118,674 (£79,384).

The Telegraph Condenser Co., Ltd., announce a final dividend of 12½ per cent and a cash bonus of 5 per cent, making 22½ per cent for 1960 on a capital increased by a 1-for-2 scrip issue. This compares with a previous equivalent distribution of 23½ per cent. Group trading profits contracted from £773,222 to £720,398. Depreciation

absorbs £84,930 (£76,266), amortisation of parent company expenditure £40,000 (nil) and tax £295,576 (£348,488). Credits relating to previous years amounted to £40,677 (£27,814). After placing £150,000 (£200,000) to general reserve, a balance of £195,265 (£180,990) remains to be carried forward.

New Companies

L. R. Duncum & Co., Ltd.—Registered 10th February. Capital £100. Electrical engineers, general electrical and refrigeration contractors, manufacturers of and dealers in radio and television sets, etc. Directors: L. R. Duncum and Mrs. Jean B. Duncum. Secretary: R. W. B. Kneen. Regd. office: 199, Godstone Road, Whyteleafe, Surrey.

Renterprises, Ltd.—Registered 13th February. Capital £5,000. Manufacturers and repairers of, agents for and wholesale and retail dealers in artificial lighting apparatus, electrical plant, machinery, fittings and accessories, radio and television sets, etc. Directors: D. Hutchinson (secretary) and J. Priestley. Regd. office: 90, Southgate, Elland, Yorks.

R. K. Bryant, Ltd.—Registered 13th February. Capital £500. Electrical engineers and contractors, radio, television, lighting and heating engineers, etc. Directors: R. K. Bryant and Mary A. L. E. Bryant. Regd. office: 79, Mile Oak Road, Southwick, Sussex.

Automatic Floor Heat, Ltd.—Registered 17th February. Capital £2,000. Electricians, mechanical engineers, manufacturers and workers of and dealers in electrical apparatus and goods, etc. Solicitor: Henry E. Goodrich, 9, Union Court, E.C.2.

Toplex, Ltd.—Registered 17th February. Capital £2,500. Manufacturers of and dealers in artificial lighting apparatus, electrical plant, machinery, fittings and accessories, radio and television sets, etc. Directors: P. J. O'Mahoney, F. Turner (secretary) and J. W. Price. Regd. office: 13, Fleming Square, Blackburn.

Divatherm, Ltd.—Registered 22nd February. Capital £100. Electricians, etc. Solicitors: Walker Martineau & Co., 10-11, Gray's Inn Square, W.C.1.

Golec, Ltd.—Registered 22nd February. Capital £5,000. Importers, exporters, manufacturers and repairers of and dealers in domestic and household electrical appliances of all kinds, including washing machines, dryers, refrigerators, radio and television sets, etc. Directors: D. Q. Jermy and Mrs. Ann P. Jermy (secretary). Regd. office: 52, High Street, Needham Market, Suffolk.

Crown Appliances (Wholesale), Ltd.—Registered 22nd February. Capital £1,000. Wholesalers of household appliances, washing machines, cookers, etc. Directors: J. F. Palmer and Eva M. Palmer (secretary). Regd. office: 18, Gipsy Hill, S.E.19.

Increases of Capital

Veritys (Maxlume), Ltd.—Increased by £50,000 in £1 ordinary shares, beyond the registered capital of £100,000, on 12th July, 1960.

Marconi International Marine Communication Co., Ltd.—Increased by £1,000,000 in £1 shares, beyond the registered capital of £2,500,000, on 20th July, 1960.

Liquidations

Milburns (Bradford), Ltd., retailers of electrical and household goods, 417, Rooley Lane, Bradford, 4.—Liquidator, Mr. R. W. Hellyer, Brotherton Chambers, Westgate, Leeds, 1, appointed 2nd February with a committee of inspection.

Wm. Gregory (Electrical Installations), Ltd., electrical engineers and retailers of electrical

and fancy goods, 28, High Street, Sutton-on-Sea, Lincs.—Winding up voluntarily. Liquidator, Mr. F. A. Ricks, Sherwood Buildings, Sherwood Street, Nottingham, appointed 9th February.

Merseyside Engineering (Refrigeration), Ltd., domestic appliance importers and distributors, 150, Caryl Street, Liverpool.—Liquidator, Mr. R. P. Booth, 5, Rumford Place, Liverpool, appointed 7th February with a committee of inspection.

Ventura (Lighting), Ltd., lighting specialists, 43, Portland Road, London, W.11.—Winding up voluntarily. Liquidator, Mr. F. E. Antill, 116, Gloucester Place, London, W.1, appointed by members on 10th February. Particulars of claims to the liquidator by 12th March. This notice is formal; all known creditors have already been paid in full.

Mayfair Electric, Ltd., radio and television dealers, 3, Shepherd Market, London, W.1.—Liquidator, Mr. S. G. Banister, 15, Golden Square, London, W.1, appointed 17th February, with a committee of inspection.

Jon Electrics, Ltd., radio, television and electrical engineers and contractors, 29-30, Bedford Row, London, W.C.1.—Winding up voluntarily. Liquidator, Mr. R. A. Hawken, Bank Chambers, 1, John Street, Bedford Row, London, W.C.1, appointed 22nd February.

M. J. Fairman, Ltd., retailers of electrical appliances and electrical contractors, 272, High Street, Rochester, Kent.—Liquidator, Mr. R. A. Hawken, 1, John Street, Bedford

Row, London, W.C.1, appointed by creditors on 14th February.

Electrahome, Ltd. (creditors' voluntary liquidation).—Particulars of claims to the liquidator, Mr. R. A. Hawken, Bank Chambers, 1, John Street, Bedford Row, London, W.C.1, by 15th March.

Bracealm Electrical, Ltd., 44, Kennedy Street, Manchester, 2, formerly of 313, Stockport Road, Manchester, 13.—Winding-up order made 13th February.

Bankruptcies

Mary Hilda Gibson, trading as Housewives Electrical Aids, 17, Vincent Road, Woolwich, London, S.E.18, electrical dealer.—Receiving order made 13th February on a creditor's petition.

N. J. Parkes and J. R. Parkes, formerly carrying on business in co-partnership with another as retailers of domestic appliances under the style of Trivox Electric at 54, Corwen Avenue, Harpurhey, Manchester.—Last day for receiving proofs for dividend 14th March. Trustee, Mr. W. H. Meredith, 20, Byrom Street, Manchester, 3.

N. G. Morgan, electrician, 28, Major Road, Canton, Cardiff.—Trustee, Mr. W. H. Meredith, County Court Buildings, Westgate Street, Cardiff, released 17th February.

A. Robinson, electrician, carrying on business at 47a, Newbold Road, Chesterfield, Derbyshire.—Receiving order made 22nd February on debtor's petition.

TRADE MARK APPLICATIONS

APPLICATIONS have been made for the registration of the following trade marks. Objections may be entered up to the dates stated:—

22nd March

Flexistrip. No. B796,602. Class 9. Electrical connections in strip form for use in printed circuits.—Telegraph Condenser Co., Ltd., Wales Farm Road, North Acton, London, W.3.

Tequipment (design). No. B805,304. Class 9. Pattern generators, waveform generators, oscilloscopes and monoscope signal generators, all being electronic instruments and apparatus used in the television industry. **Design.** No. B802,242. Class 9. Electrical and electronic instruments and apparatus.—Tequipment, Ltd., 313, Chase Road, Southgate, London, N.14.

Supersonic. No. B797,741. Class 9. Sound reproducing and radio and television receiving instruments and apparatus.—Chassay Bros. (PVT), Ltd., Bulawayo, Southern Rhodesia. Address for service: Marks & Clerk, 57 and 58, Lincoln's Inn Fields, London, W.C.2.

Thermaster. No. B802,242. Class 9. Instruments incorporating a temperature sensing head, for measuring and indicating temperature.—Sifam Electrical Instrument Co., Ltd., Leigh Court, Higher Lincombe Road, Torquay, Devon.

Floton. No. B806,321. Class 9. Magnetic suspension apparatus.—Sangamo Weston, Ltd., Great Cambridge Road, Enfield, Middlesex.

Tylec. No. 808,287. Class 9. Electrical control panels for lighting, heating and power installations; and electrical conduits.—Troughton & Young (Manufacturers), Ltd., Imperial Court, Basil Street, Knightsbridge, London, S.W.3.

Microchief. No. 811,744. Class 9. Mechanical, electronic and pneumatic measuring instruments.—Tesa S.A., Vaud, Switzerland. Address for service: George Ham & Co., 93-94, Chancery Lane, London, W.C.2.

Janitor. No. 812,321. Class 9. Electrically operated domestic floor cleaning, polishing, scrubbing, carpet-cleaning and carpet-shampooing machines; polish sprayers, and vacuum cleaners.—R. G. Dixon & Co.,

Ltd., Capitol Works, Empire Way, Wembley, Middlesex.

Miracoal. No. 809,916. Class 11. Electric fires which simulate coal fires.—Berry's Electric, Ltd., 85-86, Newman Street, Oxford Street, London, W.1.

1st April

Leisure (design), No. 800,333, and **Leisure-time**, No. 800,328. Class 7. Washing and drying, dish-washing, ironing, wringing, hair-drying and other machines. **Leisure** (design). No. 800,334. Class 9. Electrical or electronic apparatus for automatically controlling the operation of industrial or domestic machinery, and thermostats, thermometers and time switches.—Allied Ironfounders, Ltd., 28, Brook Street, London, W.1.

Elgalite. No. B805,775. Class 9. Scientific and electrical apparatus and instruments.—Elga Products, Ltd., Lane End, Bucks.

Microstat (design). No. 807,499. Class 9. Electric vacuum cleaners. Kent Company, Inc., New York, U.S.A. Address for service: Stevens, Langner, Parry & Rollinson, 5-9, Quality Court, Chancery Lane, W.C.2.

Hithene. No. 808,368. Class 9. Insulated electric wire and cable and insulated electric conductors in strip form.—Falk, Stadelmann & Co., Ltd., 91, Farringdon Road, London, E.C.1.

Coffeematic. No. 809,129. Class 9. Electric coffee makers and domestic electric coffee grinders.—Landers, Frary & Clark, New Britain, Connecticut, U.S.A. Address for service: Stevens, Langner, Parry & Rollinson, 5-9, Quality Court, Chancery Lane, W.C.2.

Servocord. No. B810,376. Class 9. Electrical instruments and apparatus for recording and indicating data.—Perkin-Elmer, Ltd., 11, Old Jewry, London, E.C.2.

Soldac. No. 810,974. Class 9. Electrical computing apparatus. **Solac.** No. 807,339. Class 11. Electric fans and ventilating installations and heating installations.—Solartron Electronic Group, Ltd., Solartron Works, Queens Road, Thames Ditton, Surrey.

Wilkata. No. 813,249. Class 9. Electrical and electronic apparatus.—Europak, Ltd., New York, U.S.A. Address for service: Trade Mark Owners Association, Ltd., 15, Finsbury Circus, London, E.C.2.

NEW PATENTS

Electrical Specifications Recently Published

The numbers under which the specifications will be printed and abridged are given in parentheses. Copies of any specification (3s 6d each including postage) are obtainable from the Patent Office, 25, Southampton Buildings, London, W.C.2

1956

8754. Elliott Brothers (London), Ltd.—Information storage systems. 20th March, 1957. (862364.)

17296. Electric & Musical Industries, Ltd.—Electric automatic control mechanism. 5th June, 1957. (862454.)

30440. Associated Electrical Industries, Ltd.—Pulse frequency dividers and their use as memory or storage elements. 3rd January, 1958. (862321.)

32427. Kemp, W. D.—Method and apparatus for producing television signals. 24th January, 1958. (862237.)

33283. M.L. Aviation Co., Ltd.—Electrical testing apparatus. 30th January, 1958. (862253.)

39061. Berry's Electric Magicoal, Ltd.—Electric radiators. 25th November, 1957. (862288.)

1957

2932. National Research Development Corporation.—Automatic control systems. 16th April, 1958. (862322.)

7620. Siemens-Schuckertwerke A.G.—Methods of testing neutron radiation. 7th March, 1957. (862425.)

7750. Philips Electrical Industries, Ltd.—Frequency transformation devices. 8th March, 1957. (862426.)

15156. Indiana General Corporation.—Magnetic separators. 13th May, 1957. (862524.)

15739. Westinghouse Electric Corporation.—Secondary emissive electrodes. 17th May, 1957. (862211.)

18798. Sick, E.—Photo-electric control system, in particular for control by marks. 14th June, 1957. (862394.)

21896. Sangamo Weston, Ltd.—Movable coil electrical instruments. 10th July, 1957. (862420.)

23158. C. A. Parsons & Co., Ltd.—Inductive windings. 9th July, 1958. (862267.)

27272. Associated Electrical Industries, Ltd.—Sequence control apparatus. 19th August, 1958. (862323.)

28411. Ericsson Telephones, Ltd.—Desk telephone instruments. 9th September, 1957. (862395.)

34797. Associated Electrical Industries, Ltd.—Street lighting lanterns. 3rd November, 1958. (862292.)

34885. Standard Telephones & Cables, Ltd.—Data storage and data processing devices. 8th November, 1957. (862270.)

35643. Standard Telephones & Cables, Ltd. (International Standard Electric Corporation).—Tuning arrangements for resonators of electron velocity modulation tubes. 15th November, 1957. (862432.)

1958

1848. United Kingdom Atomic Energy Authority.—Nuclear reactors. 1st December, 1958. (862324.)

3914. Licentia Patent-Verwaltungs G.m.b.H.—Pocket lamp with built-in mains battery charger. 6th February, 1958. (862302.)

4295. Telemecanique Electrique.—Delayed action electric switches. 10th February, 1958. (862294.)

4921. Parsons & Marine Engineering Turbine Research & Development Association.—Gas turbine power plants. 4th December, 1958. (862385.)

9840. General Electric Co., Ltd.—Control arrangements for electric motors. 16th March, 1959. (862295.)

14475. A.E.I.-John Thompson Nuclear Energy Co., Ltd.—Nuclear reactors. 21st May, 1959. (862389.)

15710. Carr Fastener Co., Ltd.—Electrical switches. 7th May, 1959. (Cognate application 37300, 19th November, 1958.) (862327.)

16334. Benjamin Electric, Ltd., and Fenn, J. J.—Lampholders for double-ended tubular electric discharge lamps. 9th June, 1959. (862496.)

19479. M-O Valve Co., Ltd.—Thermionic valves. 15th June, 1959. (862448.)

21389. A. H. Hunt (Capacitors), Ltd.—Electrical capacitors. 2nd October, 1959. (Cognate application 23668, 23rd July, 1958.) (862455.)

23793. United Kingdom Atomic Energy Authority.—Amplifiers. 14th July, 1959. (862480.)

27225. Pye, Ltd.—Apparatus for checking television waveforms. 18th August, 1959. (862328.)

29358. United Kingdom Atomic Energy Authority.—Nuclear particle discriminators. 26th August, 1959. (Addition to 823263.) (862331.)

32235. Soc. des Forges et Ateliers du Creusot.—Automatic control means for electrically driven mine hoisting machinery. 9th October, 1958. (862514.)

32737. Mullard, Ltd.—Microwave transmission device. 14th October, 1958. (862311.)

32939. Associated Electrical Industries, Ltd.—Communication systems. 13th October, 1959. (862377.)

34981. Bristol Co.—Balanceable electrical network. 31st October, 1958. (Addition to 734999.) (862450.)

36138. Automatic Telephone & Electric Co., Ltd.—Selector switches for use in automatic telephone switching systems or the like. 29th October, 1959. (861827.)

36243. Associated Electrical Industries, Ltd.—Inductor generators. 6th November, 1959. (862347.)

37384. General Electric Co., Ltd.—Resonance isolators. 11th November, 1959. (862451.)

37546. Siemens-Schuckertwerke A.G.—Neutron detectors. 21st November, 1958. (862379.)

38093. Commissariat à l'Énergie Atomique.—Nuclear reactors. 26th November, 1958. (861513.)

38662. General Electric Co., Ltd.—Machines suitable for use in mass production processes. 25th November, 1959. (Addition to 832347.) (862459.)

39280. Ericsson Telephones, Ltd.—Photoconductive cells. 13th October, 1959. (862034.)

40581. Clino Foundry Supplies, Ltd.—Electric arc furnaces. 10th December, 1959. (861923.)

40777. Automotive Products Co., Ltd.—Remote electrical indicating devices. 27th November, 1959. (862317.)

1959

1087. Crompton Parkinson, Ltd.—Electric lighting fittings. 24th December, 1959. (862936.)

2911. Goldman, A. D., and Goldman, Y.—Method and apparatus for winding armature cores. 27th January, 1959. (862483.)

3764. Burndy Corporation.—Insulated electrical connectors. 3rd February, 1959. (862255.)

4764. Kienzle Apparate G.m.b.H.—Electrical calculating apparatus. 11th February, 1959. (862338.)

8952. United States Atomic Energy Commission.—Compartmented nuclear reactor fuel element. 16th March, 1959. (862464.)

13661. Western Electric Co., Inc.—Computers. 22nd April, 1959. (862257.)

16279. Mechanical Products, Inc.—Circuit-breakers. 12th May, 1959. (862259.)

16768. Bendix-Westinghouse Automotive Air Brake Co.—Fluid pressure electric switch. 15th May, 1959. (862408.)

22609. United-Carr Fastener Corporation.—Electrical contacts. 1st July, 1959. (861426.)

25827/8. Electric Storage Battery Co.—Deferred action electric battery. 28th July, 1959. (861805/6.)

29635. Shell International Research Maatschappij N.V.—Process for the preparation of moderator graphite for use in nuclear reactors. 31st August, 1959. (862221.)

31462. G-V. Controls, Inc.—Thermal time-delay relay. 15th September, 1959. (862491.)

32518. Busch-Jaeger Durener Metallwerke A.G.—Electric switches. 24th September, 1959. (863112.)

32831. Telefunken G.m.b.H.—Automatic frequency control in carrier telegraphy receivers. 28th September, 1959. (862452.)

36912. Philips Electrical Industries, Ltd.—Semiconductor devices. 30th October, 1959. (862453.)

37377. Standard Telephones & Cables, Ltd.—Electric remote indication systems. 4th November, 1959. (862138.)

37671. Hadley Telephone & Sound Systems, Ltd.—Loudspeaking intercommunication systems. 6th November, 1959. (862262.)

39692. Maschinenfabrik P. Pfenningsberg G.m.b.H.—Washing and drying machines. 23rd November, 1959. (862522.)

40126. Kraemer, H., and Herr, E.—Pump unit with electric motor. 26th November, 1959. (862415.)

40200. Philips Electrical Industries, Ltd.—High tension transformers. 26th November, 1959. (863059.)

Street Lighting Plans

Manchester Highways Committee proposes to spend £107,700 on conversions from gas to electric street lighting in residential areas and £18,050 on new installations in 1961-62, a total of £125,750.

The lighting of Bath Road, Park Lane and Rodbourne Road, **Swindon**, is to be improved at a cost of £4,942.

The provision of sodium lighting in **Ealing** at a cost of £64,500 is recommended by the Works and Highways Committee.

Middlesbrough Town Council is to order equipment for a proposed street lighting scheme to be carried out this year at a cost of over £31,000. The work is expected to be started in April.

Croydon Highways and Street Services Committee has approved a scheme for the carrying out of the next stage in the programme for improving street lighting throughout the borough. This provides for installing 60 W sodium lanterns in various roads at a total estimated cost of £82,000.

The next stage of the street lighting improvement scheme at **Twickenham**, which the Corporation has approved for inclusion in the 1961-62 programme, is estimated to cost £57,000.

Great Yarmouth Corporation is recommended to approve a scheme, estimated to cost £4,300, for the replacement of the street lighting columns and fittings in North Drive and over Jellicoe Road Bridge.

United States Electrical Trade

ANALYSIS OF EXPORTS AND IMPORTS IN 1959

THE value of electrical goods exported by United States manufacturers showed a further decline in 1959 when the total achieved was £343 million compared with £359 million in 1958 and £365 million in 1957. Imports on the other hand increased to £87 million compared with £57 million in 1958 and £52 million in 1957.

The importance of Canada as a market for United States electrical goods is clearly brought out in Table 1 and exports increased in 1959 by 10 per cent. Exports to the United Kingdom were lower at £7.2 million (£8 million in 1958) but imports from this country increased sharply from £9 million in 1958 to £17 million in

1959. Imports from Western Germany were, at £17.4 million, slightly above those from the U.K., but the principal supplier by a wide margin was Japan. Imports from this source more than doubled in 1959 and reached a total of £26.4 million. They were concentrated on a narrow range of products, mainly radio apparatus.

TABLE 1.—UNITED STATES ELECTRICAL EXPORTS
PRINCIPAL MARKETS

Country	Value (£000)
United Kingdom ...	7,430
Canada ...	86,220
Mexico ...	14,530
Guatemala ...	1,447
Nicaragua ...	499
Costa Rica ...	901
Panama ...	1,241
Cuba ...	9,811
Jamaica ...	615
Colombia ...	4,063
Venezuela ...	23,364
Ecuador ...	1,133
Peru ...	3,089
Chile ...	3,541
Brazil ...	10,825
Uruguay ...	537
Argentina ...	6,852
Sweden ...	3,418
Norway ...	731
Holland ...	2,377
Belgium-Luxembourg ...	4,381
France ...	5,126
Denmark ...	1,202
West Germany ...	6,544
Switzerland ...	3,011
Spain ...	2,133
Italy ...	7,727
Turkey ...	3,366
Lebanon ...	770
Iraq ...	795
Iran ...	3,126
Israel ...	935
Egypt ...	283
Kuwait ...	732
Saudi Arabia ...	884
Libya ...	369
India ...	2,021
Pakistan ...	2,064
Thailand ...	1,611
Vietnam, Laos and Cambodia ...	792
Indonesia ...	825
Philippines ...	6,915
Malaya and Singapore ...	482
Taiwan ...	1,593
Japan ...	8,253
Australia ...	4,144
New Zealand ...	489
Morocco ...	303
Belgian Congo ...	625
South Africa ...	2,915
Total exports to all markets ...	343,006

TABLE 2.—UNITED STATES ELECTRICAL IMPORTS
PRINCIPAL SUPPLIERS

Country	Value (£000)
United Kingdom ...	17,100
Canada ...	8,026
Sweden ...	1,573
Denmark ...	715
Holland ...	5,452
Belgium-Luxembourg ...	1,261
France ...	1,592
West Germany ...	17,433
Austria ...	399
Switzerland ...	3,982
Italy ...	2,153
Hong Kong ...	1,188
Japan ...	26,437
Total imports from all countries ...	87,362

TABLE 3.—UNITED STATES ELECTRICAL EXPORTS
PRINCIPAL PRODUCTS

Product	Value (£000)	Product	Value (£000)
Generators, d.c.	375	Rectifiers, non-rotary, incl. battery chargers ...	1,533
Canada ...	51	Canada ...	583
Mexico ...	50	Italy ...	101
Brazil ...	59	Switchboards, panels and parts above 750 V, n.e.s. ...	4,953
Generators, a.c.	1,593	Canada ...	419
Canada ...	348	Mexico ...	227
Mexico ...	211	Cuba ...	147
Venezuela ...	304	Venezuela ...	663
Norway ...	105	Argentina ...	963
Italy ...	105	Brazil ...	320
Generator sets, steam turbine, 500 to 7,500 kW	1,346	Spain ...	414
Mexico ...	135	India ...	123
Brazil ...	511	Japan ...	222
Sweden ...	115	Switchboards, panels and parts below 750 V, n.e.s. ...	2,083
Japan ...	145	Circuit-breakers and switches, oil, and parts	1,636
Ditto, over 7,500 kW	4,556	Ditto, others	5,836
Venezuela ...	1,477	Canada ...	2,036
Cuba ...	178	Mexico ...	475
Canada ...	50	Cuba ...	218
Brazil ...	148	Venezuela ...	476
Spain ...	306	Brazil ...	236
Japan ...	2,366	Philippines ...	183
Arc welders, d.c.	2,443	Fuses and fuse plugs	610
Canada ...	299	Lightning arrestors, chokes and parts, n.e.s.	653
Mexico ...	256	Watt-hour meters	535
Colombia ...	73	Indicating instruments, non-recording ...	1,173
Venezuela ...	191	Canada ...	466
Brazil ...	88	Recording instruments	622
Arc welders, a.c., incl. a.c./d.c. welders	736	Testing and measuring instruments and parts, n.e.s.	6,036
Resistance welding sets	701	Canada ...	1,492
Generator sets, diesel	6,611	France ...	735
Canada ...	243	Italy ...	699
Peru ...	76	Turkey ...	276
Mexico ...	513	Japan ...	248
Cuba ...	115	Australia ...	146
Venezuela ...	956	Motors, under ½ h.p.	1,846
Brazil ...	282	Canada ...	875
Argentina ...	328	Mexico ...	114
West Germany ...	1,000	Canada ...	511
Iran ...	208	Motors, ½ to 1 h.p.	198
Saudi Arabia ...	223	Ditto, 1 to 200 h.p.	3,511
Generator sets, self-contained, excluding diesel, over 0.75 kW	3,393	Canada ...	781
Canada ...	285	Mexico ...	363
Venezuela ...	232	Venezuela ...	266
Italy ...	272	Chile ...	105
Turkey ...	184	India ...	37
Batteries, storage, lead acid, 6 and 12 V	1,032	Philippines ...	133
Ditto, n.e.c.-cell	535	Ditto, above 200 h.p.	2,463
Batteries, flashlight, cell	1,493	Canada ...	60
Batteries, dry, multiple-cell, except flashlight	1,432	Mexico ...	242
Capacitors for power factor correction	319	India ...	33
Transformers, power, not over 500 kVA	2,533	Japan ...	69
Cuba ...	233	Electric propulsion motors for land vehicles ...	7,601
Venezuela ...	632	Canada ...	3,022
Philippines ...	366	Venezuela ...	71
Ditto, over 500 kVA	2,366	Brazil ...	213
Mexico ...	56	Australia ...	600
Cuba ...	203	Pakistan ...	983
Venezuela ...	292	Australia ...	598
Brazil ...	755	Motor controls and parts, special purposes, n.e.s.	2,002
Austria ...	181	Canada ...	712
Transformers, instrument	455	Mexico ...	246
Fluorescent ballasts	1,277	Chile ...	76
Regulators	712	Italy ...	133
Transformers, speciality	973	Austria ...	398
Transformer and regulator parts and accessories	624	West Germany ...	133
Rotary converters up to 150 kW	608	Portable tools, metal working	2,066
Canada ...	131	Canada ...	1,235
Mexico ...	16		
Ditto, above 150 kW	611		
Brazil ...	248		
Mexico ...	74		

UNITED STATES ELECTRICAL TRADE. TABLE 3—continued

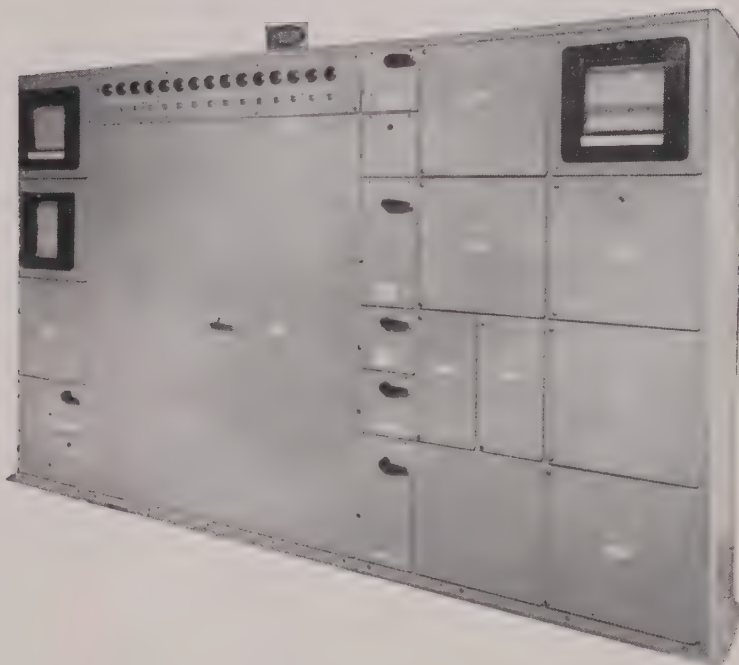
Product	Value (£000)	Product	Value (£000)	Product	Value (£000)
Portable tools, metal working, n.e.s. ...	1,598	TV receivers (continued)		Pole line, distribution and transmitting equipment ...	3,112
Canada ...	965	Venezuela ...	1,463	Canada ...	1,155
Ditto, parts, n.e.s. ...	1,486	Peru ...	736	Cuba ...	142
Canada ...	1,078	Switzerland ...	65	Brazil ...	61
Household refrigerators ...	15,322	Iran ...	595	Interior wiring devices and parts, n.e.s. ...	3,833
Canada ...	3,845	Electronic receiving tubes ...	5,251	Canada ...	1,984
Cuba ...	1,101	Canada ...	1,593	Cuba ...	147
Venezuela ...	3,523	Mexico ...	672	Venezuela ...	317
Peru ...	213	Australia ...	133	Fluorescent lighting fixtures, interior	515
South Africa ...	266	Brazil ...	238	Incandescent lighting fixtures ...	555
Lebanon ...	336	Argentina ...	695	Portable incandescent lamps ...	471
Iran ...	956	Italy ...	343	Insulated cables and wires for building	942
Freezers, farm and home ...	3,689	TV camera tubes ...	601	Venezuela ...	135
Canada ...	2,487	Cathode ray tubes, n.e.s. ...	318	Canada ...	81
Sweden ...	318	United Kingdom ...	55	Cuba ...	55
Household refrigeration units	552	Canada ...	65	Wires and cables, communication and	
Refrigerator and freezer parts ...	3,383	France ...	51	signal ...	3,463
Canada ...	2,255	Electronic capacitors ...	2,183	Canada ...	261
Mexico ...	164	Canada ...	825	Cuba ...	46
Philippines ...	141	Mexico ...	262	Turkey ...	163
South Africa ...	107	Argentina ...	348	Korea ...	763
Flashlights ...	487	Electronic resistors ...	1,482	Portable cords, wires and cables	392
Fans, free air circulating ...	1,511	Canada ...	483	Wires, cables, rubber-covered, plain,	
Canada ...	485	Electronic inductors, transformers and		braided, excl. those for building ...	1,184
Mexico ...	131	coils ...	1,411	Canada ...	152
Cuba ...	211	Canada ...	336	Mexico ...	81
Venezuela ...	293	Argentina ...	195	Pakistan ...	59
Bulbs, lamps, small filament, miniature		Italy ...	148	Cuba ...	48
small base ...	2,711	Loudspeakers ...	762	Wires and cables, varnish cambric	
Cuba ...	135	Electronic components, n.e.s. ...	13,911	insulated ...	202
Canada ...	963	France ...	495	Power cables, leaded or armoured ...	83
Ditto, large base and filament ...	1,253	Canada ...	5,652	Wires and cables, insulated, n.e.s. ...	3,193
Canada ...	337	Mexico ...	834	Canada ...	1,806
Cuba ...	145	Argentina ...	971	Steam turbines ...	3,903
Venezuela ...	187	Italy ...	372	Canada ...	365
Fluorescent lamps ...	1,716	Brazil ...	186	Mexico ...	276
Household washing machines, non-		Carrier current equipment and parts ...	941	Chile ...	62
automatic ...	1,193	Canada ...	342	Argentina ...	153
Canada ...	238	Mexico ...	73	Japan ...	674
Venezuela ...	605	Telegraph apparatus and parts, wire ...	2,822	Taiwan ...	448
Ditto, semi- or fully-automatic ...	3,664	Canada ...	1,253	Brazil ...	107
Canada ...	1,885	Cuba ...	125	Sweden ...	475
Venezuela ...	725	Venezuela ...	124	Denmark ...	274
Ditto, parts ...	1,873	Telephone instruments ...	44	Water turbines ...	36
Canada ...	1,232	Telephone equipment and parts ...	8,712	Steam and water engines, turbine parts	6,154
Mexico ...	290	United Kingdom ...	944	Canada ...	1,054
South Africa ...	55	Canada ...	2,260	Mexico ...	351
Electric laundry equipment and parts,		Cuba ...	1,002	Venezuela ...	1,432
n.e.s. ...	488	France ...	171	Cuba ...	57
Household vacuum cleaners ...	1,473	Venezuela ...	197	Italy ...	225
Canada ...	1,440	Recorders, all kinds ...	3,908	Saudi Arabia ...	188
Ditto, parts ...	525	Canada ...	991	Taiwan ...	666
Household dishwashers ...	822	United Kingdom ...	334	Japan ...	531
Canada ...	561	Italy ...	288	Nuclear reactors, all types ...	126
Switzerland ...	75	Bells, buzzers, alarms and parts ...	1,006	West Germany ...	5
Mixers, juicers and blenders, household		Starting, lighting and ignition equip-		Greece ...	3
Canada ...	561	ment for cars and industrial engines	12,110	Italy ...	89
Other motor-driven household applian-		Canada ...	4,684	Japan ...	29
ces ...	3,036	Mexico ...	1,004	Ditto, parts and accessories ...	412
United Kingdom ...	94	Venezuela ...	1,122	Canada ...	40
Canada ...	1,798	Brazil ...	248	Sweden ...	10
Mexico ...	151	Iron and steel conduit ...	1,194	Belgium ...	146
Switzerland ...	87	Conduit fittings, outlets and switch-		Italy ...	59
Italy ...	71	boxes ...	2,183	West Germany ...	103
Flat irons ...	54	Cuba ...	86		
Venezuela ...	189	Canada ...	825		
Cookers, household, over 2.5 kW ...	683	Venezuela ...	277		
Canada ...	223				
Cuba ...	96				
Ditto, parts ...	1,611				
Canada ...	1,334				
Household storage heaters ...	246				
Household appliances, n.e.s. ...	1,526				
Equipment for cooking and food service,					
and parts, n.e.s. ...	771				
Furnaces, melting, refining, industrial ...	411				
Canada ...	46				
Turkey ...	47				
Ditto, heat treating, industrial ...	1,198				
Heating units and devices, industrial,					
and parts, n.e.s. ...	1,411				
Canada ...	535				
X-ray tubes and valves, medical, dental					
and industrial ...	485				
X-ray apparatus and parts, n.e.s. ...	2,351				
Canada ...	916				
Mexico ...	86				
Cuba ...	64				
Venezuela ...	127				
Colombia ...	52				
Radio transmitting (a.m. and f.m.) equip-					
ment and parts ...	1,298				
Canada ...	143				
Mexico ...	91				
Venezuela ...	86				
France ...	183				
Spain ...	129				
Iran ...	126				
Car radio receivers ...	638				
Canada ...	168				
Mexico ...	170				
Venezuela ...	173				
Radio receivers, n.e.s., not incorporat-					
ing TV sets ...	1,443				
Canada ...	388				
Cuba ...	84				
TV receivers ...	6,324				
Canada ...	613				
Cuba ...	1,293				

TABLE 4.—UNITED STATES ELECTRICAL IMPORTS
PRINCIPAL PRODUCTS

Product	Value (£000)	Product	Value (£000)
Generators and parts, n.e.s. ...	2,316	Ditto, 200 h.p. and over ...	92
United Kingdom ...	1,753	United Kingdom ...	33
Sweden ...	131	Canada ...	22
West Germany ...	74	Switzerland ...	18
Switzerland ...	218	Ditto, parts ...	181
Transformers and parts ...	2,311	United Kingdom ...	43
United Kingdom ...	1,393	West Germany ...	70
West Germany ...	125	Radio apparatus and parts ...	25,814
Switzerland ...	539	United Kingdom ...	1,093
Italy ...	141	Canada ...	824
Converters, generators, etc., dynamotors		Holland ...	1,463
and parts, n.e.s. ...	331	West Germany ...	2,214
United Kingdom ...	82	Japan ...	19,886
Canada ...	43	Telephone apparatus ...	2,322
Japan ...	106	United Kingdom ...	91
Articles, n.e.s., for controlling and recti-		Canada ...	831
fying electrical energy ...	3,725	Belgium ...	212
United Kingdom ...	613	West Germany ...	501
Canada ...	963	Switzerland ...	500
Holland ...	451	X-ray tubes ...	141
France ...	122	Photo-cell and electronic tubes, n.e.s. ...	485
West Germany ...	268	United Kingdom ...	27
Switzerland ...	418	Canada ...	236
Japan ...	675	Lead acid type storage batteries and parts	166
Motors, below 1/2 h.p. ...	553	Storage batteries and parts, other ...	370
United Kingdom ...	76	Flashlights and cases ...	543
West Germany ...	117	Hong Kong ...	435
Japan ...	273	Japan ...	79
Ditto, 1/2 to 200 h.p. ...	1,421	Furnaces, heaters, ovens and parts ...	684
United Kingdom ...	1,221	United Kingdom ...	72
Belgium ...	48	Canada ...	49
West Germany ...	99	West Germany ...	345

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Our range includes —

DISTRIBUTION FUSEBOARDS WITHOUT
AND WITH BUILT-IN ISOLATORS

RIISING MAIN BUSBARS WITH
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ING CONTROL

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FUSED TAP OFFS

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MULTI-TIER MOTOR CONTROL PANELS

L.T. AIR CIRCUIT BREAKERS

Our cubicle and pedestal type
switchboards are flexible in
design, neat, compact, are front
access for wiring and save money

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THE SIZE 'O' DONOVAN A.C. DIRECT-ON-LINE CONTACTOR STARTER

This starter features an interlocked load breaking isolating switch, mechanically interlocked with lid (but interlock can be, if necessary, "defeated" for test and inspection) and thus normally, when the lid is open, live parts are shielded. The use of a starter with combined interlocked isolating switch, makes for SAFETY and ECONOMY.

The latter because one piece of apparatus instead of two is used with consequent reduced installation costs.

Other features of this attractively finished direct-on-line contactor starter are:—

Contactor starter interior is chassis mounted and easily changed; thermal overload heaters for contactor starter, to suit different horse powers, easily fitted; isolating switch (load

breaking type) will switch up to eight times current of maximum full load H.P., at power factors between .2 to .3 and the switch is chassis mounted and can be padlocked "ON" or "OFF". The sheet steel case, bonderised before painting and stoving, has a "lift-off" lid for easy access and can be padlocked closed. A neoprene gasket is fitted in lid.

DIMENSIONS AND RATING DATA

Box size only $11\frac{1}{4}" \times 7" \times 4\frac{1}{8}"$.

Rating: 5 h.p. 400/550v 3 phase.

Starters can be supplied with Start-Stop pushes in lid, or Over-load reset button only in lid, or with "Auto-Off-Hand" control. Whole assembly complies with B.S.587. Contactor with B.S.775, and Isolating Switch with B.S.61.

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**A.S.E.E. EXHIBITION
STAND F2, GROUND FLOOR**



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NEXT WEEK'S EVENTS

Organisers of electrical functions are advised to make use of the "Electrical Review" clearing house, Room 221, Dorset House, Stamford Street, London, S.E.1, to ascertain that proposed dates for their functions do not clash with others already arranged.

MONDAY, 13th MARCH

Arboretfield.—Unit Cinema, Training Bn., R.E.M.E., 7 p.m. I.E.E. London Graduate and Student Section. "The Work of the B.B.C. with Particular Reference to Transmitters," by R. W. Leslie.

Birmingham.—College of Technology, Gosta Green, 6 p.m. I.E.E. South Midland Supply and Utilisation Group Meeting. "The Determination of the Electrical Characteristics of an Arc Furnace," by J. Ravenscroft.

Bournemouth.—Grand Hotel, Firvale Road, 8 p.m. A.S.E.E. Bournemouth and District Branch. "Tape Recording of A.S.E.E. Diploma Scheme Examination."

Cambridge.—Technical College, 6.30 p.m. I.E.E. East Anglian Sub-Centre. Discussion on "The Broadening of University Engineering and Science Courses," to be opened by Prof. H. E. M. Barlow.

Cardiff.—South Wales Institute of Engineers, 6 p.m. I.E.E. Western Centre. "Silicon Power Rectifiers," by A. J. Blundell, A. E. Garside, R. G. Hibberd and I. Williams.

Glasgow.—Royal College of Science and Technology, 6 p.m. I.E.E. Scottish Electronics and Measurement Group. Discussion on "Digital Transducers."

Leicester.—Westcotes Constitutional Club, Wilberforce Road, 7.30 p.m. A.S.E.E. Leicester Branch. Buffet dance.

Liverpool.—M.A.N.W.E.B. Electrical Industrial Development Centre, Paradise Street, 7 p.m. I.E.E. Mersey and North Wales Graduate and Student Section. "Recovery Properties of High Current Spark Gap Switches," by R. J. Churchill.

London.—Savoy Place, W.C.2, 5.30 p.m. I.E.E. informal meeting. Discussion on "Town Planning and Electrical Requirements," to be opened by L. H. Welch.

Newcastle-on-Tyne.—Neville Hall, 6.30 p.m. I.E.E. North Eastern Centre. "A Basis for Short-Circuit Ratings for Paper-Insulated Cables up to 11 kV," by L. Gosland and R. G. Parr, and "Short-Circuit Ratings for Mains Cables," by G. S. Buckingham.

Sheffield.—Grand Hotel, 6.30 p.m. I.E.E. Sheffield Centre. "The Use of Coloured Light," by H. Hewitt.

Wembley.—Century Hotel, 8.15 p.m. A.S.E.E. North West London Branch. "Electric Clocks," by D. F. Burgess.

TUESDAY, 14th MARCH

Broadstairs.—Clarendon Hotel, 8 p.m. A.S.E.E. East Kent Branch. "Oil-fired Boilers and Associated Equipment," by S. Austin.

Cardiff.—Park Hotel, Park Place, 7.30 p.m. A.S.E.E. South Wales Branch. "Control Centres for Modern Industries."

Catterick Camp.—H.Q. Mess, School of Signals, 6.15 p.m. I.E.E. North Midland Centre. "Developments in Lighting," by F. A. Benson.

Edinburgh.—Carlton Hotel, 7 p.m. I.E.E. Scottish Electronics and Measurement Group. Discussion on "Digital Transducers."

Farnborough.—Queen's Hotel, Lynchford Road, 8 p.m. A.S.E.E. Aldershot and Districts Branch. "Codes of Practice," by S. J. Emerson.

Glasgow.—Kenilworth Hotel, Queen Street, 8 p.m. A.S.E.E. Glasgow Branch. "Electronics," by R. H. Garner.

Leeds.—Electrical Engineering Department, Leeds University, 6.30 p.m. I.E.E. North Midland Centre. Education Discussion Circle meeting. Discussion on "Refresher and Post-Graduate Courses for Electrical Engineers."

Liverpool.—Exchange Hotel, Tithebarn Street, 6.45 for 7.30 p.m. Electrical Contractors' Association, Liverpool Branch. Annual dinner.

London.—Savoy Place, W.C.2, 6 p.m. I.E.E. Education Discussion Circle. Dis-

cussion on "New Routes into National Certificate and Technician Courses," to be opened by H. W. French.

25, Foubert's Place, W.1, 6 p.m. Electrical Association for Women, London Branch. "Cameo of Holland," by A. Speller.

Memorial Building, 76, Mark Lane, E.C.3, 5.30 p.m. Institute of Marine Engineers. "Materials for Advanced Steam Conditions and their Influence on the Operation of Turbines and Boilers," by H. E. C. Hims and S. H. Frederick.

Connaught Rooms, W.C.2, 12.30 for 1 p.m. Electrical Industries Club. Luncheon. Speaker, Lieut. Phibbs, Ph.D. (U.S.A.F. Office of Information).

Loughborough.—College of Further Education, Greenclose Lane, 6.30 p.m. I.E.E. East Midland Centre. Junior members' night.

Manchester.—Engineers' Club, Albert Square, 6.15 p.m. I.E.E. North Western Centre. "The Place of Formal Study in the Post-Graduate Training of an Electrical Engineer," by N. N. Hancock and P. L. Taylor.

Engineers' Club, Albert Square, 7.15 p.m. Institution of Plant Engineers, Manchester Branch. Annual meeting.

Newcastle-upon-Tyne.—Roadway House, Oxford Street, 7.30 p.m. A.S.E.E. Newcastle-upon-Tyne and District Branch. "Taxation Matters."

Southampton.—University, 6.30 p.m. I.E.E. Southern Centre. "Analogue to Digital Converter Techniques and their Applications," by K. L. Smith.

York.—Royal Station Hotel, 7.30 p.m. A.S.E.E. York Branch. "Electrical Safety in Home and Factory," by F. Clark.

WEDNESDAY, 15th MARCH

Exeter.—Washington-Singer Laboratories, Exeter University, Prince of Wales Road, 3 p.m. I.E.E. South Western Sub-Centre. "The Shielding of Overhead Lines against Lightning," by J. H. Gridley.

London.—Institution of Civil Engineers, Great George Street, S.W.1, 6.30 p.m. I.E.E. London Graduate and Student Section. Annual joint meeting with the Graduate and Student Sections of the Institutions of Civil and Mechanical Engineers. "Space Research," by Prof. Sir Harrie Massey.

Savoy Place, W.C.2, 5.30 p.m. I.E.E. Supply Section. Discussion on "Magneto-Hydrodynamic Generation of Electricity," to be opened by P. L. Davies and D. J. Harris.

Tallow Chandler's Hall, 4, Dowgate Hill, E.C.4, 12.30 for 1 p.m. Electric Light Fittings Association. Annual luncheon.

Manson House, 26, Portland Place, W.1, 7 p.m. The Society of Instrument Technology, Data Processing Section. "Initial Experience on the Use of a Digital Computer for Burst Slug Detection," by J. L. W. Churchill and R. S. Hopkins, and "Burst Slug Detection Data Display at Bradwell," by J. O. Joss.

Manchester.—Engineers' Club, Albert Square, 6.15 p.m. I.E.E. North Western Electronics and Communications Group meeting. "The Potentialities of Artificial Earth Satellites for Radiocommunication," by W. J. Bray.

Electrical Engineering Department, Manchester University, 7 p.m. I.E.E. North Western Graduate and Student Section. "Digital Techniques in Power Engineering," by C. Ayers.

Newcastle-upon-Tyne.—Eldon Grill, Grey Street, 7 p.m. Plastics Institute, North Eastern Section. "Electrical Applications of Low-Pressure Resins," by T. R. Manley.

Nottingham.—Nottingham Mechanics' Institution, Trinity Square, 7.30 p.m. A.S.E.E. Nottingham Branch. Open forum, "Planning of Electrical Installations with Reference to Electrical Contractors and Architects."

Preston.—N.W.E.B. Demonstration Theatre, Friargate, 7.30 p.m. I.E.E. North Lancashire Sub-Centre. Second Hunter Memorial Lecture. "The Protection of Electrical Systems," by H. G. Bell.

Rochester.—King's Head Hotel, High Street, 7 p.m. Institution of Plant Engineers, Kent Branch. "The Use of Light in Industry," by A. E. Fothergill.

Rugby.—Rugby College of Engineering Technology, 6.30 p.m. I.E.E. Rugby Sub-Centre. "The Determination of the Electrical Characteristics of an Arc Furnace," by J. Ravenscroft.

Wolverhampton.—Chamber of Commerce, District Bank Chambers, Lichfield Street, 7.45 p.m. A.S.E.E. Wolverhampton and District Branch. "Summation Metering," by M. L. Dunn.

THURSDAY, 16th MARCH

Basingstoke.—New Basingstoke Technical College, Worting Road, 7.30 p.m. Institution of Production Engineers, Reading Branch. "Production Techniques in the Instrument and Telephone Industry," by H. A. Richardson.

Birmingham.—Engineering Centre, 7 p.m. Institute of Marine Engineers, West Midlands Section. "Heat Exchangers—Design Aspects to Avoid Corrosion," by G. Page.

Derby.—College of Technology, Kedleston Road, 7.15 p.m. Society of Instrument Technology, East Midland Section. "Recent Developments in Industrial Electronics," by E. Metcalf.

Edinburgh.—Adam Rooms, George Hotel, 7 for 7.30 p.m. I.E.E. Scottish Centre. Annual dinner.

London.—Savoy Place, W.C.2, 5.30 p.m. I.E.E. Utilisation Section. "A Dynamic Model for Studying the Behaviour of the Overhead Equipment used in Electric Railway Traction," by D. S. Farr, H. C. Hall and A. L. Williams.

Great George Street, Westminster, S.W.1, 5.30 p.m. Institution of Civil Engineers, Traffic Engineering Study Group. Informal discussion on "Future Developments in Traffic Light Signals."

Connaught Rooms, 12.30 for 1 p.m. British Electrical and Allied Manufacturers' Association. Council's annual luncheon, followed by annual meeting.

Porthcawl.—Seabank Hotel, 10 a.m. Combustion Engineering Association, Western Region. "Instrumentation of the Boiler House," by J. D. Rutherford.

Southampton.—University, 6.30 p.m. I.E.E. Southern Graduate and Student meeting. Discussion on "Electrical Engineering Education and Training," by R. E. Steven, K. Morgan, T. McGreevy, J. C. Scott and G. R. Rogers.

FRIDAY, 17th MARCH

Birmingham.—Imperial Hotel, Temple Street, 7.30 p.m. Institution of Plant Engineers, Birmingham Branch. Annual meeting followed by a film entitled "Economic Boiler Plant."

Hanley.—Grand Hotel, 7.30 p.m. A.S.E.E. Stoke and Crewe Branch. "Lift Installation and Maintenance," by J. E. Collins.

Harrogate.—Cairn Hotel. Electrical Industries Benevolent Association, West Yorks. Branch. Dinner/dance.

Newcastle-upon-Tyne.—Rutherford College of Technology, 6.30 p.m. I.E.E. North Eastern Graduate and Student Section. "Preparation and Presentation of Papers," by H. S. Hvistendahl. (Joint meeting with the Graduate and Student Sections of the Institutions of Civil and Mechanical Engineers.)

Sheffield.—Royal Victoria Hotel. Electrical Industries Benevolent Association, Sheffield Branch. Dinner/dance.

CONTRACT INFORMATION

Accepted Tenders and Prospective Electrical Work

CONTRACTS OPEN

Where "Contracts Open" are advertised in our "Official Notices" section the date of the issue is given in parentheses

Argentina.—Ministry of Public Works. Preparation of electrification schemes. Last date for receipt of offers 4th April. (E.S.B. 7310/61.)*

State River Fleet. 3rd April. Telecommunication equipment. (E.S.B. 6943/61.)*

Australia.—N.S.W. Electricity Commission. 17th April. Thirteen 132 kV, 3,500 MVA circuit-breakers, thirty-nine 132 kV transformers, and compressed air plant. (E.S.B. 6460/61.)*

South Australian Railways. 13th April. Two diesel-electric locomotives. (E.S.B. 6820/61.)*

Blackpool.—Corporation. 20th March. Street lighting equipment. (See this issue.)

Bolton.—Bolton and District Joint Sewerage Board. 20th March. Applications are invited from contractors wishing to be included in the Board's list for electrical work in connection with the Ringley Fold scheme. (See this issue.)

Ceylon.—Tender Board, Ministry of Agriculture, Land, Irrigation and Power. 21st March. Cables. (E.S.B. 6927/61.)*

Durham.—County Council. 22nd March. Electrical installation in Staindrop New Modern School. (See this issue.)

Formosa.—Central Trust of China. 30th March. Battery charging equipment. (E.S.B. 6477/61/I.C.A.)*

Greece.—Directorate of Fisheries. 17th May. Refrigeration installations. (E.S.B. 6937/61.)*

Hereford.—City Council. 20th March. Electrical installations in bungalows. (See this issue.)

India.—Punjab State Electricity Board. 20th March. Thirty-eight 300, 500 and 750 kV indoor distribution transformers. (E.S.B. 6841/61.)* 10th April. 225 400 V, 22 MVA oil circuit-breaker panels. 2nd May. 125 11 kV, 150 MVA o.c.b. panels. (E.S.B. 6842/61.)*

S.E. Railway, Calcutta. 31st May. Colour-light signalling. (E.S.B. 6807/61.)*

Chittaranjan Locomotive Works. 16th May. Substation equipment and cable. (E.S.B. 7375/61.)*

National Coal Development Corporation. 1st April. Cable couplers. (E.S.B. 7368/61.)*

Irish Republic.—18th March. Electrical distribution scheme at County Hall, Wexford. Nicholas Matthews & Co., consulting engineers, 42, Fitzwilliam Place, Dublin.

Italy.—N.A.T.O. Infrastructure Contracts. 10th May. Telephone cables (Contract 9956), switchboard (Contract 9957), 20 desk type telephone sets (Contract 9958) and h.f. telephone system (Contract 9959). Applications to tender by 10th March. (G.D. 303/61 (91-94).)†

Lanarkshire.—County Council. 24th March. Trunk road lighting extensions. (See this issue.)

Lebanon.—Ministry of Posts, Telegraphs and Telephones. 25th March. Telephone equipment. (E.S.B. 6935/61.)*

London.—Wandsworth Borough Council. 30th March. Applications are invited from firms wishing to be placed on the Council's list of electrical contractors. (See this issue.)

New Zealand.—G.P.O., Wellington. 24th April. Telephone equipment. (E.S.B. 7302/61.)* 25th April. Switches. (E.S.B. 7303/61.)* Radio transmitter/receiver. (E.S.B. 7301/61.)*

Waitemata Electric Power Board. 12th May. 33/11 kV transformer. (E.S.B. 7314/61.)*

Northern Ireland.—24th March. Electric heating and lighting installation in new offices for the Taxation Department at Mount Crescent, Downpatrick. Barrett & Agnew, consulting engineers, 420, Ravenhill Road, Belfast.

Norway.—N.A.T.O. Infrastructure Contract. 15th April. Construction work at airfield, including electrical distribution and lighting systems. Applications to tender by 20th March. (G.D. 158/60(22).)†

Pakistan.—Director-General of Supply and Development. 21st March. Cable. (E.S.B. 6960/61.)* 31st March. Batteries. (E.S.B. 6991/61.)*

Portuguese East Africa.—Government Purchasing Department. 20th March. Electrical equipment. (E.S.B. 7360/61.)*

Rhodesia and Nyasaland.—Salisbury City Council. 11th April. Cable. (E.S.B. 6979/61.)* 18th April. Transmission line equipment. (E.S.B. 6982/61.)* 25th April. Transformers. (E.S.B. 6981/61.)*

Rugby.—R.D.C. 27th March. Sewage pumps, with motors, starting gear, automatic control apparatus, etc., for Frankton sewerage. Pick, Everard, Keay & Gimson, consulting engineers, 6, Millstone Lane, Leicester.

Singapore.—City Electricity Department. 21st March. Street lighting equipment. (E.S.B. 6499/61.)* Insulated cable. (E.S.B. 6500/61.)*

Turkey.—Karayollari Umum Mudurlugu, Ankara. 21st March. 100 electric drills. (E.S.B. 6861/61.)*

United States.—Bureau of Reclamation, Denver. 17th March. Three outdoor transformers. (E.S.B. 6811/61.)* 21st March. One auto-transformer. (E.S.B. 6814/61.)*

ORDERS PLACED

Chelmsford.—Housing Committee. Electrical installation work in multi-storey block of flats, Melbourne estate (£6,073).—Christy Bros. Electrical equipment (£2,298).—Bocking of Braintree.

Darlington.—Education Committee. Electrical work in additions to the Darlington College of Further Education (£22,104).—J. Paterson & Son.

Durham.—County Council. Electrical work at E. F. Peile County Convalescent Home (£1,377).—William Brothers (Electrical). Electrical installation, East Boldon residential nursery (£1,079).—Campbell & Isherwood.

London.—L.C.C. Supply and fixing of electric water heaters in 352 flats, Becontree, Essex (£19,735), 219 dwellings at Kenmore Park estate, Middlesex (£13,851) and other dwellings at Ossulston estate, St. Pancras (£9,994).—F. J. Baynes & Co. Electrical installations in blocks 1-4, Kilner Street site, Stepney (£4,953).—Electric Contracts (London). Electrical installations in blocks 1-10, Pier Street, Poplar (£7,575).—Holliday (Electrical).

Romford.—Borough Council. Recommended. Electrical installation work in the Town Hall extension (£1,264).—K. J. Bromley.

WORK IN PROSPECT

Particulars of new works and building schemes for the use of electrical installation contractors and traders. Publication in this section is no guarantee that electrical work is definitely included. Alleged inaccuracies should be reported to the Editors

Aberdeenshire.—Senior secondary school at Bankhead (£229,000); county architect, 55, Queens Road, Aberdeen.

Alton.—Houses (92), Manor estate; Gregory Housing, Ltd., 21, Farncombe Road, Worthing.

Barwell (Leics.).—Extensions to footwear factory; Bell & Wright, Ltd., High Street.

Bath.—Offices and laboratories, Kingsmead; Bristol Avon River Board, 18, Bennett Street.

Bristol.—Rural science block, Greenway School; city architect.

Chesterfield.—Final stage of College of Technology; county architect, Matlock.

Glasgow.—Works extensions; Albion Motors, Ltd., South Street.

Grimsby.—Synthetic rubber factory; Revertex, Ltd., Harlow New Town, Essex.

Lincolnshire.—Two-form entry school in Postland Road, Crowland; county architect, Boston, Lincs.

London.—Office block, 98/103, Great Russell Street, Bloomsbury; J. Seymour Harris & Partners, architects, 4, Greenfield Crescent, Birmingham, 15.

Newcastle-on-Tyne.—Shops and offices, corner of Percy Street and Gallowgate; Sanderson, Townend & Gilbert, 3, Mosley Street.

Newcastle (Staffs.).—Civic centre and hall, The Brampton (£99,000); borough engineer, Lancaster Buildings.

Norwich.—Houses, maisonnettes and flats (100), Barclay Road/Woodside Road area, Heartsease estate; D. Percival, city architect.

Nottingham.—Flats (51), Mapperley Road; Bernard Sunley & Sons, Ltd., 25, Berkeley Square, London, W.1.

Nuneaton.—Divisional police headquarters, Vicarage Street/Wheat Street site (£124,800); county architect, Shire Hall, Warwick.

Scunthorpe.—Hostel, Dawes Road; Richard Thomas & Baldwins, Ltd., Redbourne Works.

Slough.—Dwellings (235), Langley estate; borough engineer.

Stanley (Co. Durham).—Shops and offices, Front Street; Marshall & Tweedy, architects, 36, Blackett Street, Newcastle-on-Tyne.

Stockton-on-Tees.—Remodelling Grange-field Grammar School (£178,000); borough architect, 28, The Square.

Swindon.—Courts of justice; Bare, Leaning & Bare, quantity surveyors, 31, Faringdon Road.

Tonbridge.—Extensions and alterations to Tonbridge School (about £100,000); Sir William Holford & Partners, architects, 2, Angel Court, Throgmorton Street, London, E.C.2.

Wallsend.—Works extensions for Thermal Syndicate, Ltd. (£100,000); L. J. Couves & Partners, architects, Grainger Chambers, Hood Street, Newcastle-on-Tyne.

Waford.—Houses (52), Meriden estate; borough engineer, Town Hall.

Whitworth.—Houses (36), Moss Side Street, Shawforth; surveyor, Council Offices, Whitworth, near Rochdale.

Winchester.—Hotel, Cathedral Close; Fielden & Mawson, architects, 71a, The Close, Norwich.

Windsor.—Old people's hostel, Dedworth Road; J. T. Castle, architect, Wilton House, Parkside Road, Reading.

* This information is extracted from the Board of Trade Export Service Bulletin. Inquiries should be addressed to the Board of Trade, Export Services Branch, Lacon House, Theobald's Road, London, W.C.2 (Telephone: Chancery 4411, Ext. 738), quoting the reference given. † Telephone: Trafalgar 8855, Ext. 2010.



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All the bushing porcelains for the 330 kV.
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All the 330 kV. strain insulators for the
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The illustrations show a
complete 330 kV. bushing
insulator and a 330 kV.
circuit breaker, by
courtesy of the A.E.I. Co.

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ELECTRICAL ENGINEERS (A.S.E.E.) EXHIBITION
EARLS COURT, MARCH 21st-25th

BULLERS LIMITED · MILTON · STOKE-ON-TRENT · STAFFS

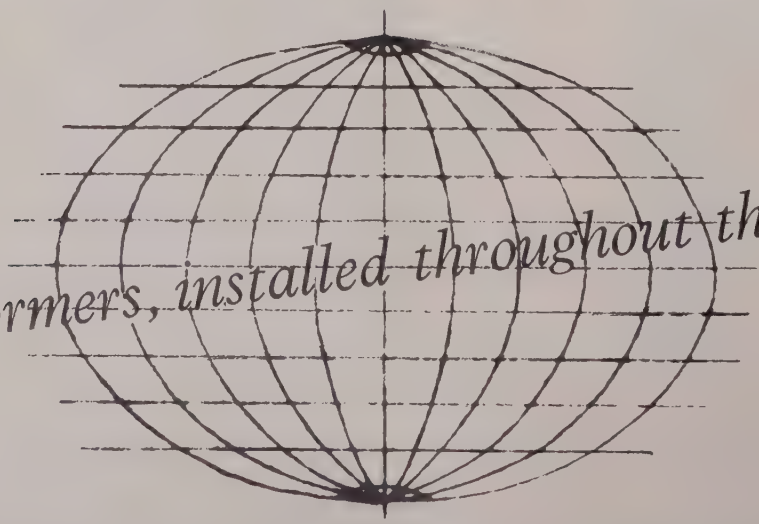
Telephone: Stoke-on-Trent 54321

London: 6, Laurence Pountney Hill, E.C.4. Telephone: MANsion House 9971



YORKSHIRE

magnetically shielded reactors



transformers, installed throughout the world

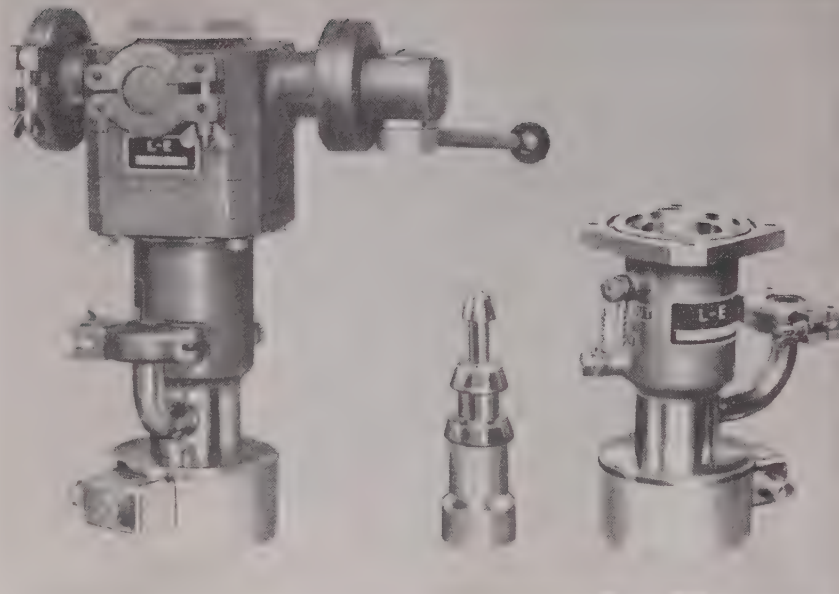


YORKSHIRE ELECTRIC TRANSFORMER CO. LTD.,
THORNHILL, DEWSBURY, YORKS. TEL: 1691-2 'GRAMS: 'TRANSFORMA, DEWSBURY'

LEYBOLD-ELLIOTT OIL DIFFUSION PUMPS

In this large range are pumps for handling through-put from 30 litres per second right up to 8,000 litres per second. Each of these compact pumps achieves low ultimate pressure, having an automatic de-gassing stage and low cooling-water consumption. All key parts are stainless steel.

A complete range of valves and accessories is available from stock for use with these pumps. Please send for full details.



The Leybold-Elliott DO30 (30-litres per second)

LEYBOLD-ELLIOTT LTD

MANOR WAY — BOREHAMWOOD — HERTS

Telephone: ELStree 3636

The APPELBE "BULB FIXER"

NO LADDERS REQUIRED

Telescopic appliance for fixing and removing electric bulbs. Any reasonable height can be reached.

Made of Aluminium and can be carried with ease on any cycle.

STANDARD MODEL

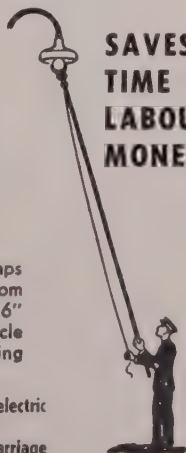
for 60 to 200 watt lamps at 16' 6" from ground. 6' 0" closed. 12' 0" extended. Weight 3 lb. Cycle clips and Extension Tubing supplied.

"A" MODEL

for 200 to 500 watt lamps E.S. Caps at 20' 0" from ground. 7' 0" closed. 16' 6" extended. Weight 5½ lb. Cycle clips and Extension Tubing supplied.

Used by the leading corporation and electric light companies throughout the world. Prices and particulars on request. Carriage Paid in Great Britain.

**SAVES
TIME
LABOUR
MONEY**



J. F. APPELBE & CO. LTD.
GREAT UNION STREET, HULL

Telephone 33522, 31212 and 8725. Telegraphic Address "Appelbeco, Hull"

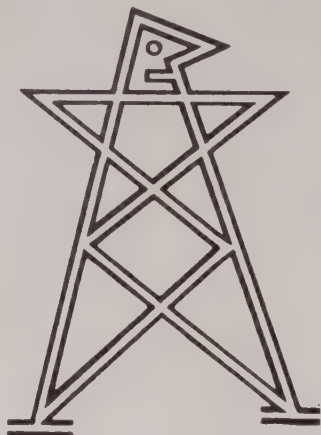
MANUFACTURERS OF ELEMENTS FOR ALL TYPES OF FIRES



**THE
ELECTRIC ELEMENTS CO.**

Tokenhouse Yard, NOTTINGHAM
Makers of Elements since 1921

Mr. Pylon directs you to



COMMUNICATIONS

FEATURE

the

TENTH

at

EARLS
COURT

ELECTRICAL ENGINEERS EXHIBITION

- Opening by The Minister of State, Board of Trade, the Rt. Hon. Frederick Erroll, M.P., at noon on March 21st.
- Seen for the first time—Britain's NEW electro-magnetically-operated railway level-crossing barrier.
- Record number of foreign dignitaries representing 45 countries will attend the opening ceremony.
- Over 470 Exhibitors at the Show—an all-time record!

MARCH
21st-25th

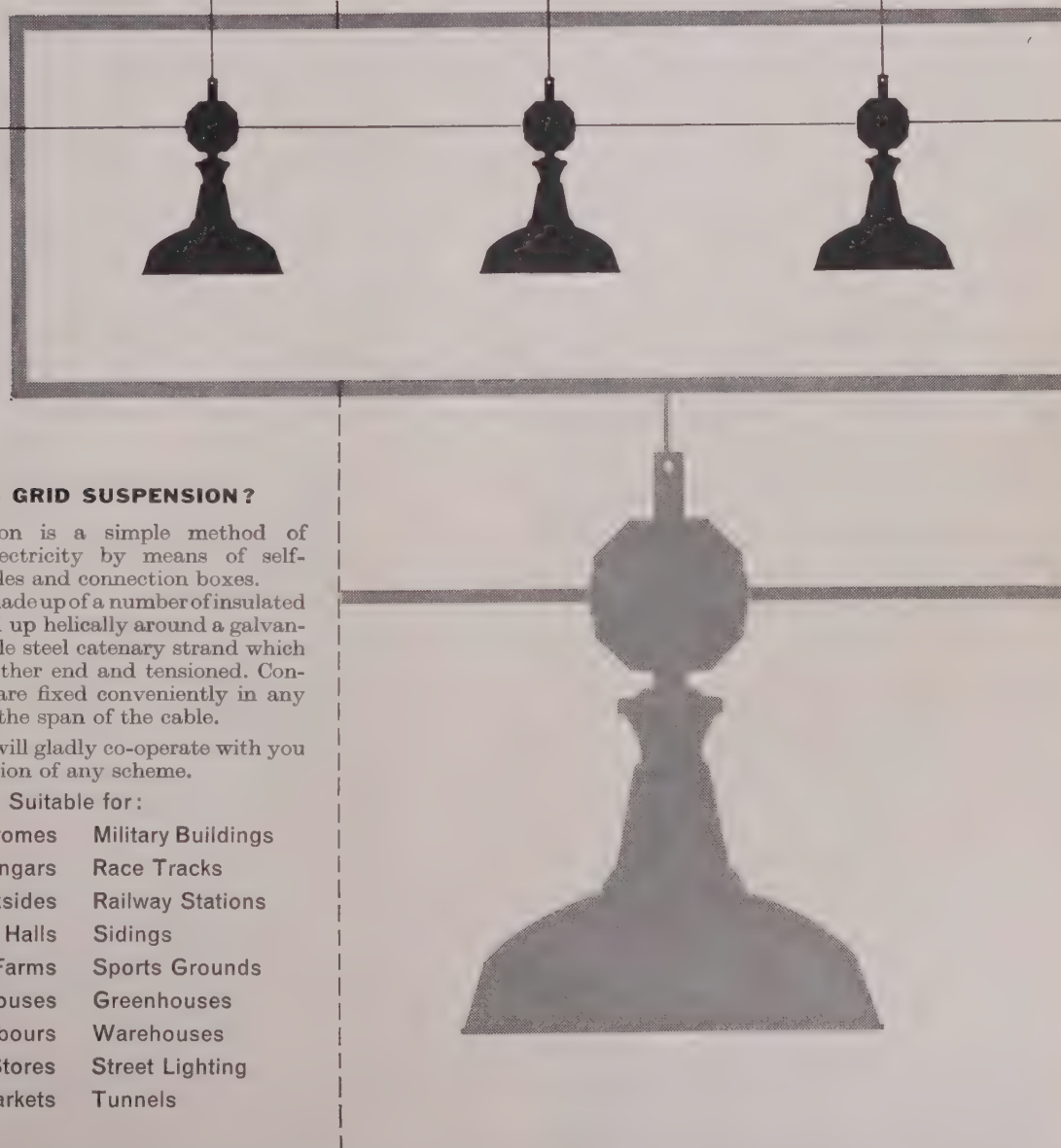
9 a.m. to 7 p.m.
(daily)
until 9 p.m. on
Wednesday, March 22nd

For details write to :

THE GENERAL MANAGER, ELECTRICAL ENGINEERS EXHIBITION, Museum House, Museum Street, London, W.C.1

Enfield-Standard

GRID SUSPENSION WIRING SYSTEM



WHAT IS GRID SUSPENSION?

Grid Suspension is a simple method of distributing electricity by means of self-supporting cables and connection boxes.

All cables are made up of a number of insulated conductors laid up helically around a galvanised, high tensile steel catenary strand which is secured at either end and tensioned. Connection boxes are fixed conveniently in any position along the span of the cable.

Our engineers will gladly co-operate with you in the preparation of any scheme.

Suitable for:

Aerodromes	Military Buildings
Aircraft Hangars	Race Tracks
Docksides	Railway Stations
Exhibition Halls	Sidings
Factories, Farms	Sports Grounds
Broiler Houses	Greenhouses
Harbours	Warehouses
Garages, Stores	Street Lighting
Markets	Tunnels



Enfield-Standard Power Cables Limited

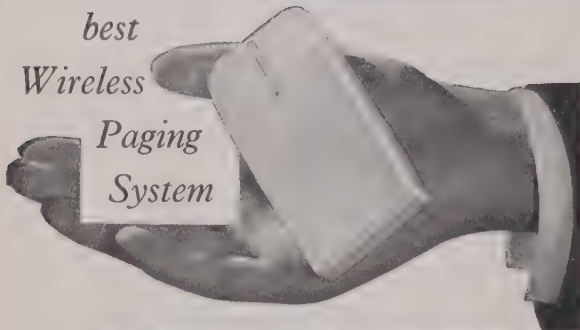
Head Office and Works

BRIMSDOWN • ENFIELD • MIDDLESEX • TELEPHONE: HOWARD 2468

IMMEDIATE CONTACT INDOORS OR OUT



*the
best
Wireless
Paging
System*



The tiny NIRA receiver in an executive's pocket gives him freedom of movement which is invaluable. Wherever he goes about the premises—to other offices or workshops, out to the transport yard—he remains always within call. No time wasted by irritating waiting for telephone calls or visitors who may not come. He and his colleagues are connected by invisible links which can be forgotten until the moment they are needed.

The NIRA system is simple and dependable. The receivers are recharged automatically when not in use—no dry batteries are used, for greater reliability and low maintenance costs. Calling is a matter of pressing a button marked with the executive's number—only the person called receives the signal.

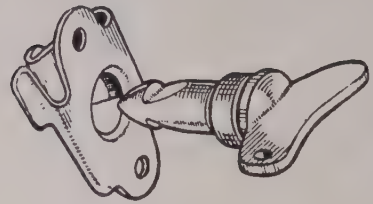
NIRA is far in advance of all other systems. Easier operation—lower installation costs—Receivers which are lighter, neater—more sensitive—fully guaranteed.

Write for the Nira illustrated folder to:

CASS ELECTRONICS LTD

CHERTSEY, Surrey Telephone: Chertsey 3487

ODDIE FASTENERS



The Fastener with endless applications. Simple, Positive, Self-locking. Made in a variety of types and sizes.

Special Fasteners to suit customers' requirements

WIDELY USED IN THE ELECTRICAL AND RADIO INDUSTRY

Department "E.R."

**ODDIE, BRADBURY & CULL LTD.
SOUTHAMPTON**

Telephone 55883

Cables: "Fasteners, Southampton"

HOUSE SERVICE METERS



Credit Pattern
and Prepayment Type
200-240 v. A.C. S/Ph 50c. (& D.C.)
AVAILABLE FROM STOCK
POLYPHASE 400-440 v. 3-wire Type
Ex Stock

UNIVERSAL ELECTRICAL CO.
217-221 City Road, London, E.C.1

If you need

a small **METAL PRESSING** for your product, why not consult us?

We specialise in light precision presswork in all metals for the Electrical Trades.

QUOTATIONS BY RETURN

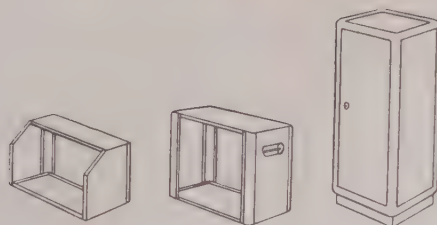
BIRMINGHAM SPECIALITIES LTD.
Moor Lane, Witton, Birmingham 6. Phone: BIRchfields 5026



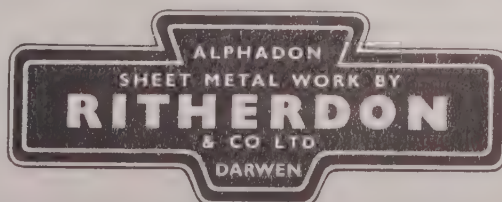
You make it — we'll case it!

MADE-TO-MEASURE
INSTRUMENT & EQUIPMENT HOUSINGS
AT ECONOMICAL COSTS

Instrument cabinets and equipment racks in formed steel sections are Ritherdon's speciality. Made-to-measure for housing communications, control and instrument equipment, these cabinets are all constructed on a 'Standard' system whatever the specified shape or size. Units of basic but flexible design (some examples are illustrated) can be constructed to meet your particular specifications at a price comparable with batch production costs. Ritherdon's method of construction saves design time and avoids the long delays and high costs of housing non-standard equipment.



Write or telephone us for further details





Wild-eyed, but a wizard with figures, this missing ex-Company Director claims he was driven frantic by his colleagues' failure to take advantage of the excellent facilities offered by **ASSOCIATED LEAD** for supplying Lead and Antimony in all their forms. Particularly, in his case, **LEAD, TIN, ANTIMONY & THEIR ALLOYS; 99.999% PURE LEAD, TIN & ANTIMONY; SOLDERS; INCLUDING SOLID & CORED SOLDER WIRE; ANTIFRICTION MATERIALS; ANTIMONIAL LEAD; CABLE ALLOYS; LEAD SHEET & PIPE; DENSE LEAD SHIELDING FOR NUCLEAR WORK.** Has a habit of muttering "Time, money..." May have fled the country.

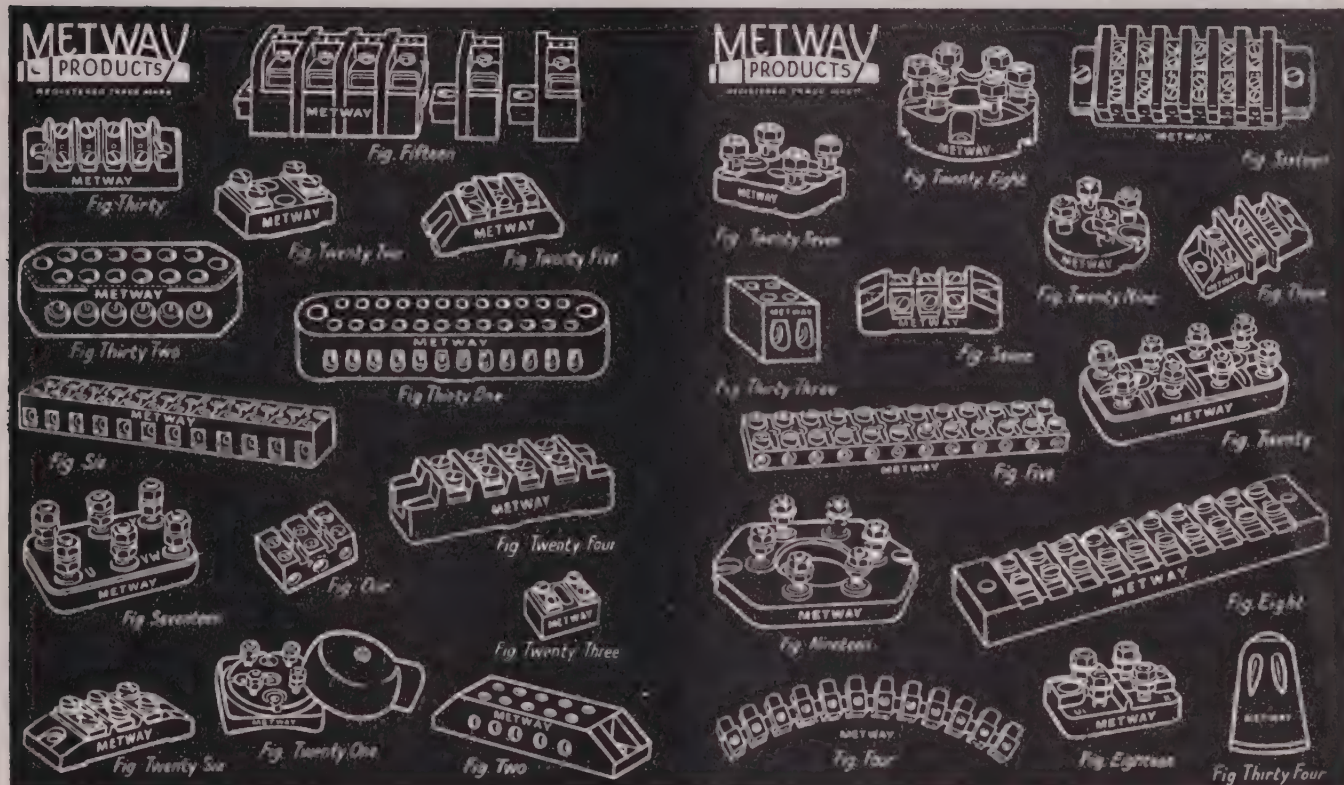
This announcement is issued for and on behalf of

ASSOCIATED LEAD MANUFACTURERS LIMITED

CLEMENTS HOUSE, 14 GRESHAM STREET, LONDON, E.C.2; CRESCENT HOUSE, NEWCASTLE; LEAD WORKS LANE, CHESTER
Export Enquiries to: Associated Lead Manufacturers Export Co. Ltd., Clements House, 14 Gresham Street, London, E.C.2

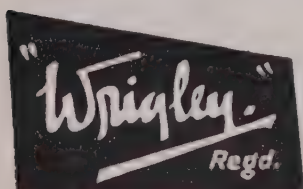


METWAY WILL BE "MAKING CONNECTIONS" AT EARLS COURT MARCH 21st-25th VISIT OUR STAND No. 12 AND SEE OUR EVER INCREASING RANGE OF TERMINAL BLOCKS

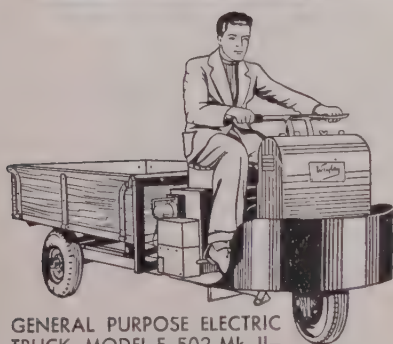


• FOR FULL DETAILS WRITE FOR CAT. No. NBQ/12 EJ.
IF YOU CANNOT VISIT THE A.S.E.E. EXHIBITION

METWAY • KEMP TOWN • BRIGHTON



...overcomes
your mechanical
handling problems!



GENERAL PURPOSE ELECTRIC
TRUCK—MODEL E. 502 Mk. II—
Capable of handling loads of
up to 15 cwt., easily and
speedily. Driver control. Over-
all length 8' 0", overall width
3' 4". Available with or with-
out sides.

Full details and illustrated leaflets will be sent on request

Other 'Wrigley' models include:
TUGS, FORK LIFT TRUCKS,
DUMPERS, PETROL TRUCKS,
TRACTORS, TIPPERS, HAND
TRUCKS AND TROLLEYS, etc.

LONDON AREA SALES & SERVICE
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188/190 Lythalls Lane
Coventry
Tel.: Coventry 88171

WESSEX INDUSTRIES (POOLE) LTD.
WEST STREET • POOLE • DORSET • Tel. 2000

DID YOU SPOT THE MISTAKE?

The following Relays were incorrectly captioned in the full page Keyswitch advertisement in the Electrical Review, February 24th issue.



(Fitted with double pole
changeover for 250 volts
2 amps.)
Ideal for simple switching
operations where light-
ness, compactness and
economy are prime consid-
erations. When fitted with
contacts similar to those
of the 'B.P.O. 3000' type
it is faster in operation
and release.

PLUG-IN 3000 Type Relays
Plug-in facilities in addition to
all the versatility and well-es-
tablished, reliable features of the
world's best known relays.

- ★ Positive contact between
male and female pins.
- ★ Contacts: up to 18 light
duty or 12 heavy duty.
- ★ Complete transistorised
units.
- ★ AC or DC operation.
- ★ Transparent or metal
cover.
- ★ Clip retains relay posi-
tively in any position.

SOCKETS AND FITTINGS
ARE AVAILABLE FROM
STOCK for immediate as-
sembly of units.

**PLUG-IN TRANSISTOR-
ISED UNIT.**

Operation AC or DC. Switch-
ing or Signal Current AC or
DC. 5 to 500 micro-amps.
Transfer switching current up
to 10 amps. or 500v.

MINOR TYPE '600'



Contact Sales Director

THE KEYSWITCH CO.
Irongate Wharf Road
Praed St., London, W.2
Tel.: PAddington 2231

Contractors to Home and Overseas
Governments and H.M. Crown Agents

**KEYSWITCH
RELAYS**

UTILAIR

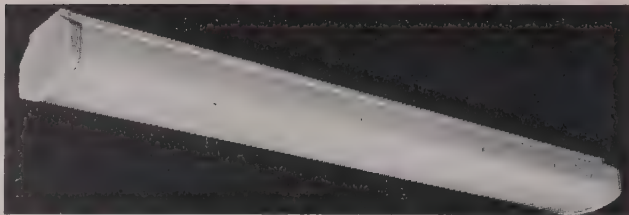
**BRITAIN'S BEST
FLUORESCENT LIGHTING
FITTINGS & CONTROL GEAR**

Starter switch
type choke
incorporating
starter holder.

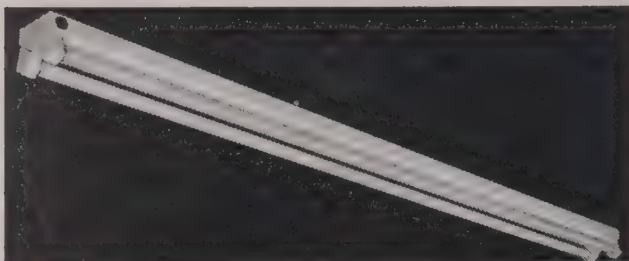
Starter switch
type high
power factor
ballast unit.

Choke with
instant start
transformer
unit.

Britain's best range
of Fluorescent Fit-
tings selected for
efficient lighting by
famous concerns
all over the world



Model EP.802 Suspended or ceiling fitting with opal fluted diffusing cover



Model D.2125 Twin 8ft. 125 watt batten fitting



Model VP.802 Industrial vapour-proof totally enclosed fitting

UTILITIES (LONDON) LTD.

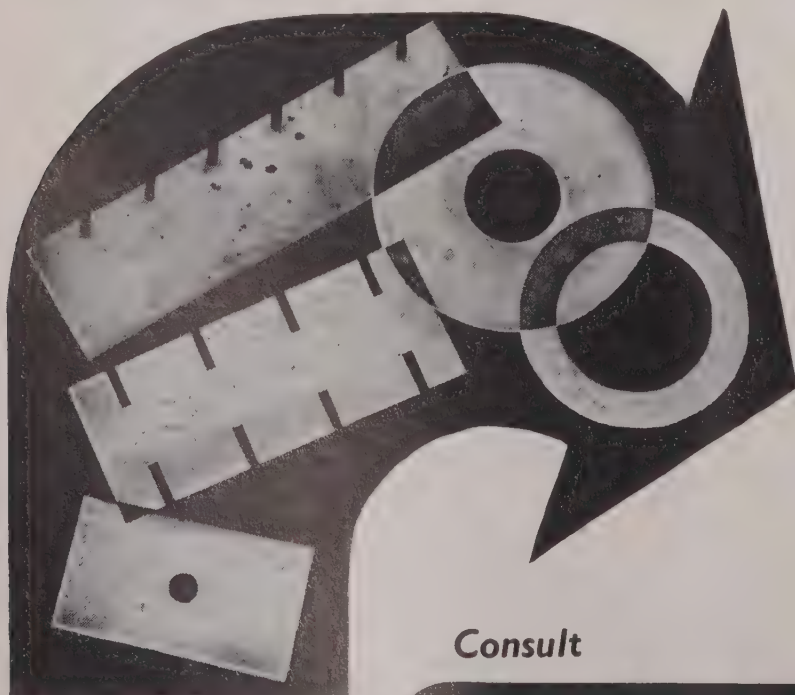
Manufacturing Electrical Engineers

TUNSTALL ROAD • BRIXTON

LONDON • S.W.9

Telephone : Brixton 6811-4

Telegrams : Utilon, London, S.W.9



for
MICA
INSULATION

Consult

EAST LONDON MICA WORKS

RINGWOOD RD., WALTHAMSTOW, LONDON, E17

ESTD. 1912

Phone
COPpermill 2248/9

Telegrams:
Elmicmer, Easphone, London

PROTECTION...



**Reyrolle ANNOUNCE A
NEW PILOT-WIRE SYSTEM**

Solkor-R

HIGH-SPEED FEEDER-PROTECTION

This system is a major advance in the art of feeder protection. It combines the most recent results of protection research with principles which have been well proved in service. Requiring only a single-pole relay and lightly insulated 2-core pilots it is both simple and economical to install, and, being based on static components, its maintenance costs are negligible.

Other features are high-speed operation, high transient stability, low fault-settings, use of ordinary current-transformers, and suitability for pilots up to 1,000 ohms resistance.

Ask for Pamphlet No. 1328

Reyrolle

A. REYROLLE & COMPANY LIMITED - HEBBURN - COUNTY DURHAM - ENGLAND

NO MORE D. C. MOTOR PROBLEMS !

E.P.E. turn D.C. problems
into D.C. motors *

Not long ago, many people thought it impossible to get D.C. motors quickly and at a reasonable price. Some people still think so.

They don't know about E.P.E.

E.P.E. specialise in D.C. equipment, combining their many years experience in this field with a keen interest in new techniques. They can supply D.C. motors and generators of any enclosure quickly and at a reasonable price.

If you've a D.C. motor problem, why not bring it along to E.P.E. ? If they haven't a solution in stock, they'll be happy to make one for you !

E.P.E.

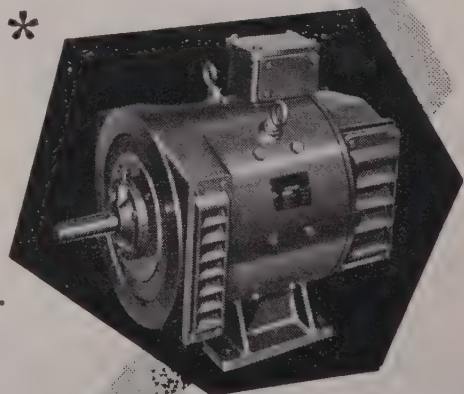
ELECTRICAL POWER ENGINEERING CO. (B'ham) LTD.

Bromford Lane, Birmingham 8. 'Phone: STEchford 2261

Grams: Torque 'Phone Birmingham

London Office: 421, Grand Buildings, Trafalgar Square, W.C.2

'Phone: WHIttehall 5643 and 7963



introducing

a magnificent new range

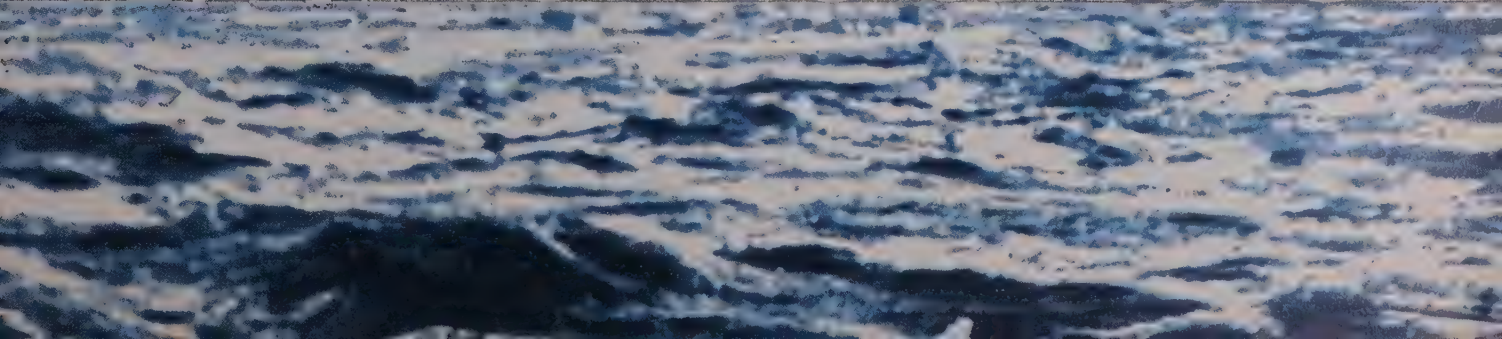
of fluorescent fittings

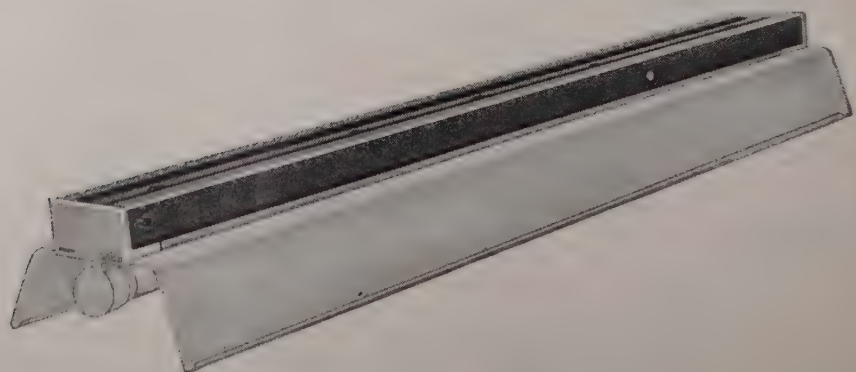
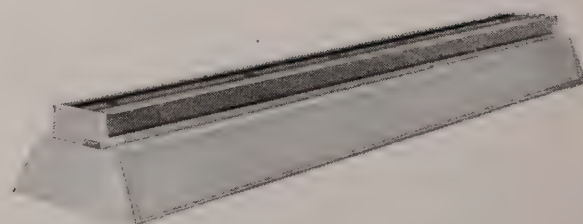
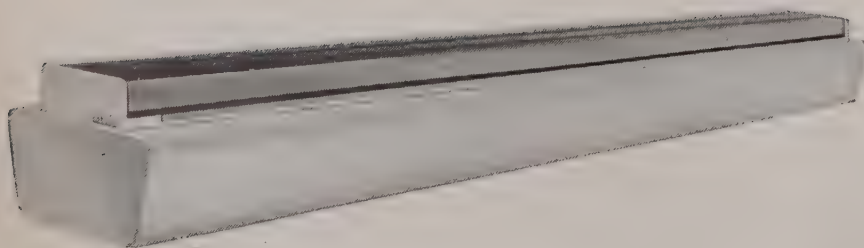
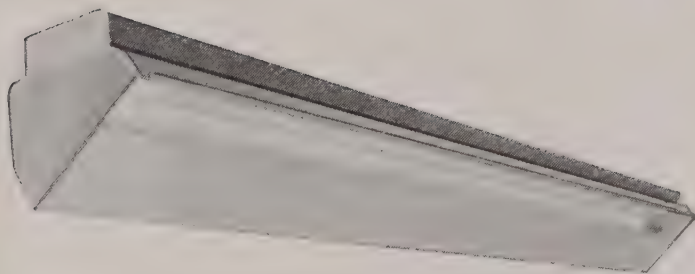
incorporating many new features

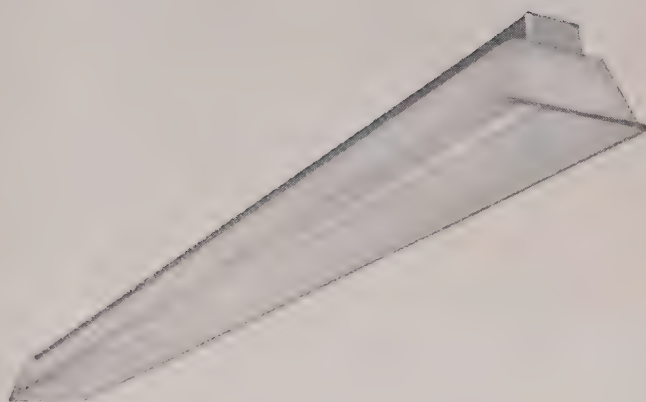
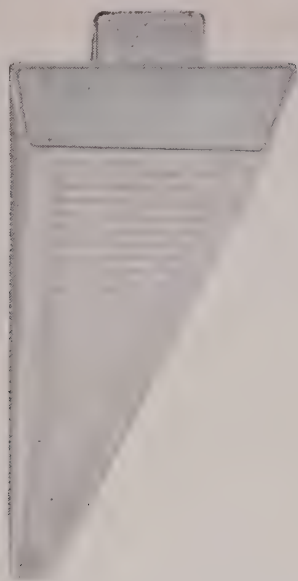
in design, finish

and ease of installation

atlas atlantic 2

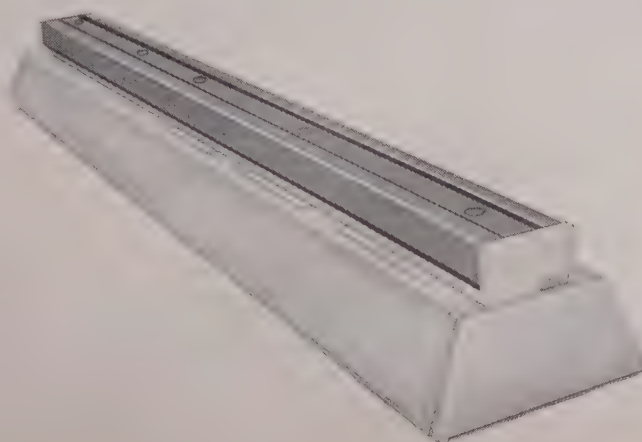
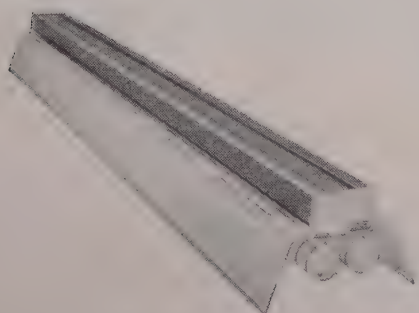




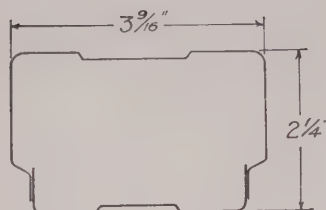


atlas atlantic 2

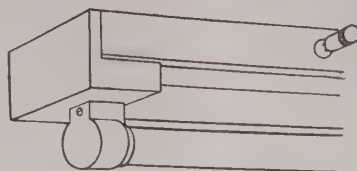
Here is a new complete family of fluorescent fittings, remarkable for outstanding appearance and a host of features with tremendous appeal on both practical and aesthetic grounds. They are built to the highest quality standards, yet offer surprisingly competitive prices. A unique spine of new slim section provides exceptional ease of installation, simple maintenance and reliability. The flexibility of this range is such that, from the one basic spine using the minimum number of interchangeable components, a wide variety of fluorescent fittings can be created to meet the precise lighting needs of almost any commercial, municipal or industrial premises. Fitting sizes cover 4 ft., 5 ft., and 8 ft., with single or double tubes, a choice of switch-or quickstart control gear, and reflector and diffuser attachments. Included in the range are fittings which accommodate the new Atlas 'Super-8' Circuit. For details of the unique design features of the Atlas Atlantic 2 spine, please see overleaf . . .



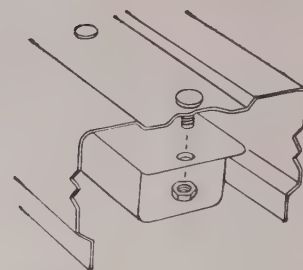
features of the new atlas atlantic 2 spine



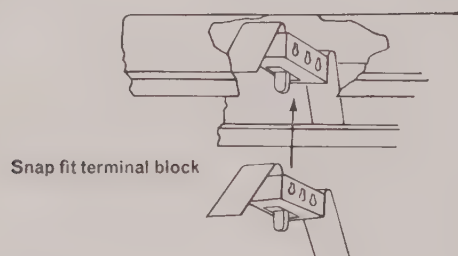
Slimmer section with more pleasing proportions.



Starter switches replaceable without dismantling. Fixed voltage gear increases reliability.



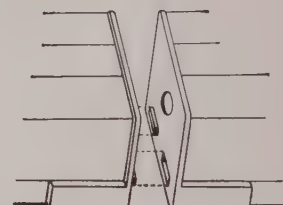
Welded screw studs for easy gear replacement



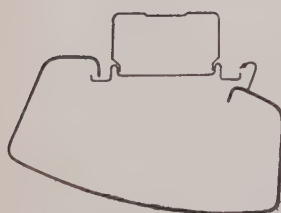
Snap fit terminal block



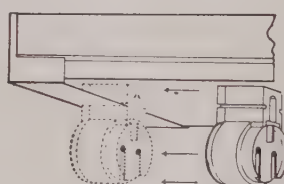
Completely closed back, drip and dust proof. Perfect seating when flush mounted.



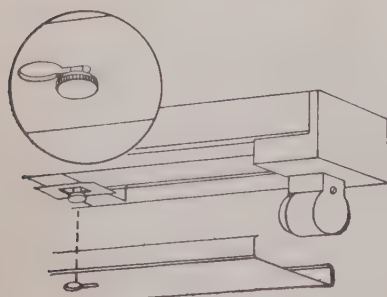
Automatic alignment when mounted in continuous runs. Rugged cast end plates.



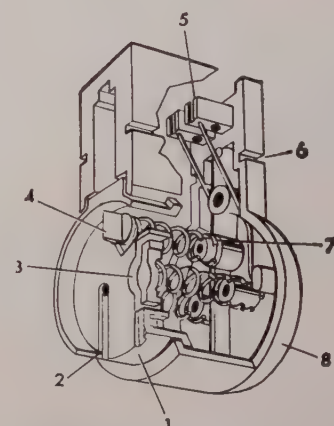
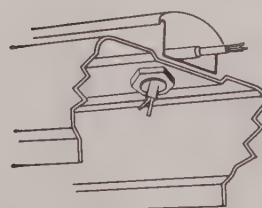
Fast, positive fixing of attachments



Improved lampholders, need no fixing, no screws

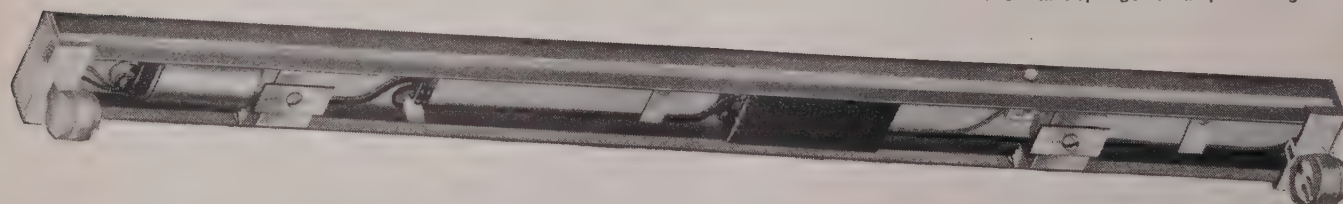


Enclosed through-wiring channels (Optional Extra)



THE NEW LAMPHOLDER

- 1 Plunger 2 Pin Guides
- 3 Double finger contacts 4 Earth Contact
- 5 Terminal connections
- 6 Lampholder support slots
- 7 Contact springs 8 Lamp Housing



atlas atlantic 2

Complete details of this outstanding new range can be seen in the Atlas Atlantic 2 catalogue, available on request to

Single component chassis, pre-wired ready to install. Finest 'Miracryl' finish superior to stove enamels and with advantages over vitreous enamels

Atlas Lighting Limited, Thorn House, Upper St. Martin's Lane, London, WC2.

There's money in **SLOTMETERS!**



James S. Graham at your service

They not only **SAVE** money but **MAKE** money, are easily installed and provide an additional income in hotels, boarding houses, caravans, flats, etc. Fixed or variable price settings. A.C. or D.C. 200/250 volts. 2½ to 50 amps. Quarterly credit meters also available. Prices from 15/-. Billiards and television meters with choice of 1d., 6d., 1/- or 2/- slot and any time setting. From £4 each.

Time switches from 55/- each.

EVERY METER FULLY GUARANTEED FOR TWO YEARS.

All goods despatched via express delivery at no extra charge. Prices include packing, carriage and padlocks for slot-meters.

Our satisfied customers include owners of hotels, boarding houses, flats, garages, caravan sites, etc. We also supply electrical contractors and wholesalers. Trade enquiries are particularly invited.

I GUARANTEE that all our factory rebuilt instruments are guaranteed for two years from date of despatch from our works. During that time we undertake to repair or replace, at our option, any defective instrument returned to us carriage paid and having our original seals intact.

James S. Graham

FREE ILLUSTRATED
BROCHURE

SPECIAL OFFER!

- Self-starting synchronous clock type motors 200/250v. 50c., from 3/6 each.

PERSONAL CALLERS INVITED AND WELCOME

JAMES S. GRAHAM & CO., LTD. (Dept. 35)

73 Acre Road, Kingston-on-Thames, Surrey

Telephone: KINGston 0075

Open all day Saturday

TESTING

IS SIMPLER
MORE EFFICIENT
SAFER

WITH THE



TEST LAMP

INDESTRUCTIBLE
MEDIUM VOLTAGE
ALL INSULATED

PRICES:

TYPE MTL 3 (shown) 36/9

TYPE MTL 1 (fixed prongs) 31/6



JOHN DRUMMOND (ENGINEERS) LTD

BELLCRAG WORKS, Dalsholm Road, GLASGOW N.W. Tel: MARyHill 3315 6

"ELMO"

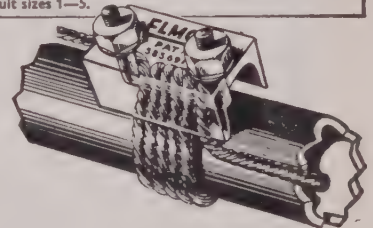
EARTHING CLAMPS

A COMPLETE RANGE TO B.S.951. 1948
IN 4 SIZES

	A123	B45	C67	D8910
for earthing cables up to	7/0.036"	7/0.064"	19/0.064"	19/0.083"
to fit B.S. conduit sizes	1, 2 & 3	4 & 5	6 & 7	8, 9 & 10
i.e. in trade terms	½" to ¾"	1" and 1½"	1½" and 2"	2½" to 3½"

NOTE ALSO: Type A123 is suitable for Earthing Cables up to 7/0.029" and for B.S. conduit sizes 1—5.

"Elmo" Earthing Clamps are of robust construction. Impossible for wire to pull out, always under tension, therefore a most satisfactory earth and a permanent safeguard.



ELECTRICAL FITTINGS



Flexible-to-rigid CONDUIT COUPLINGS

Made in zinc base alloy in the following sizes:

Electric Thread (Male) ⅝" ¾" 1" 1¼" 1½" 2"

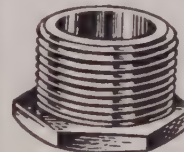
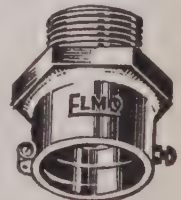
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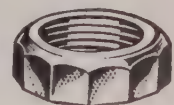
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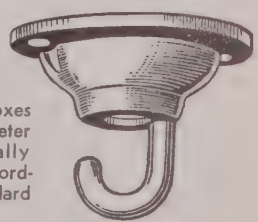


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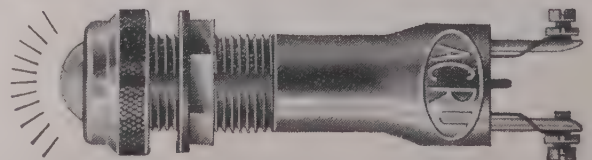
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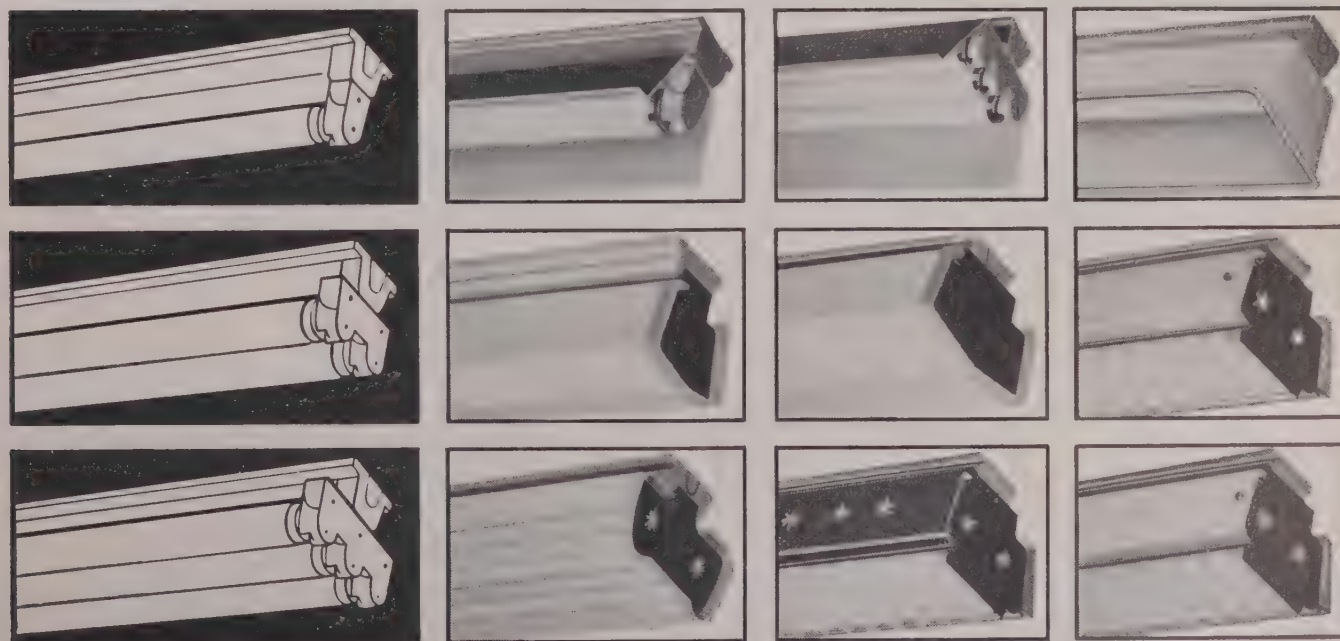
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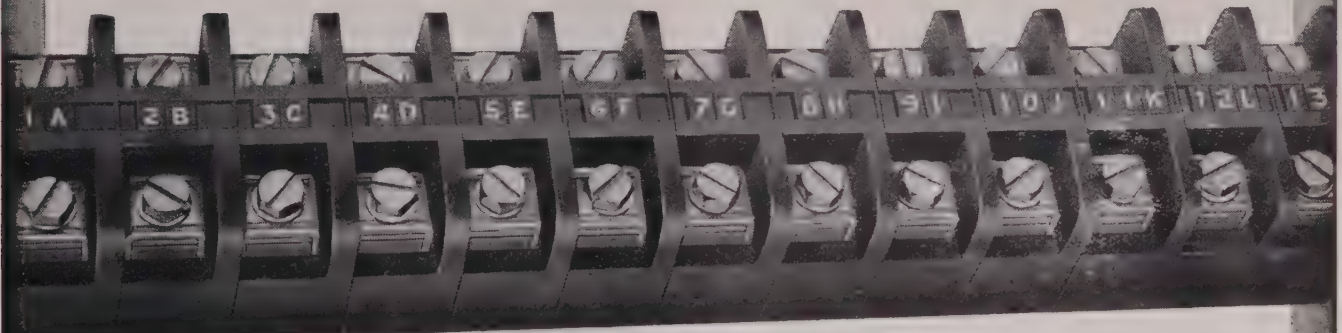
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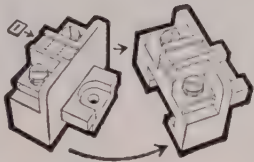
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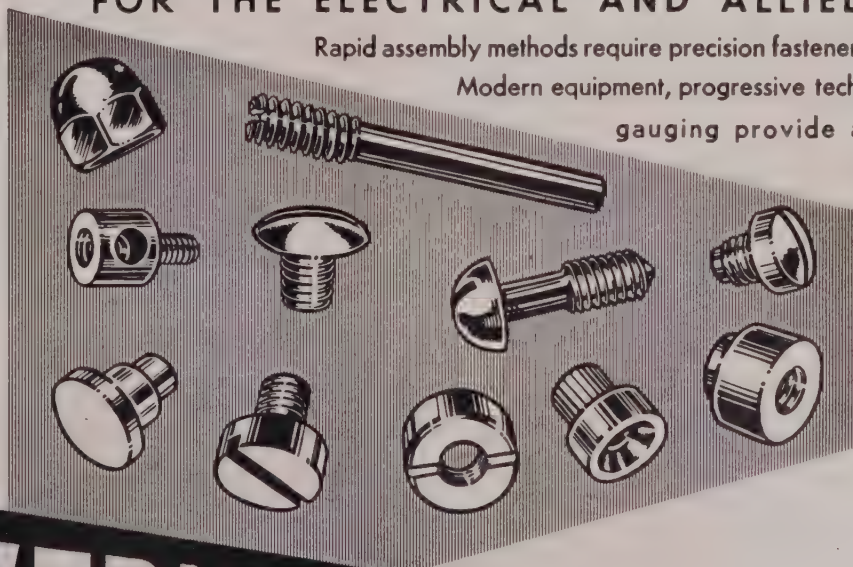
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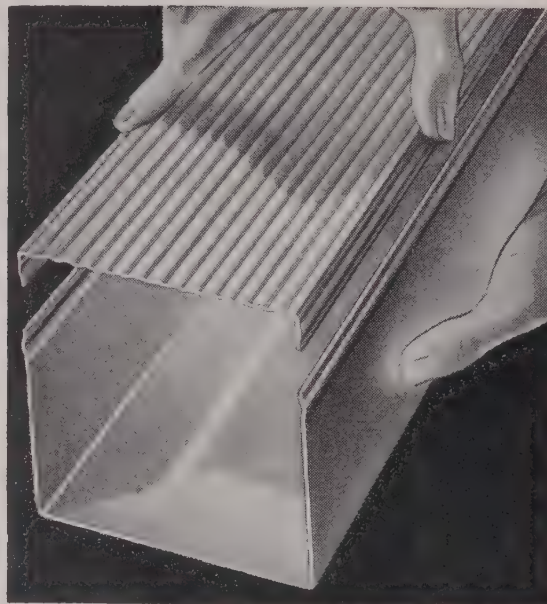
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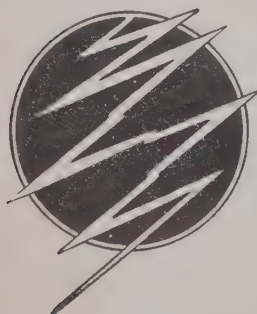


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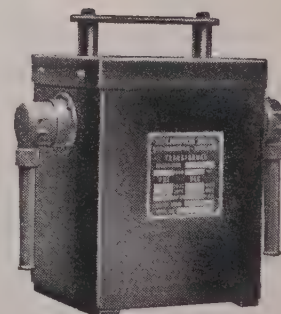
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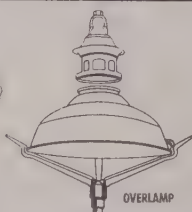
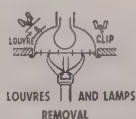


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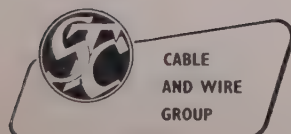
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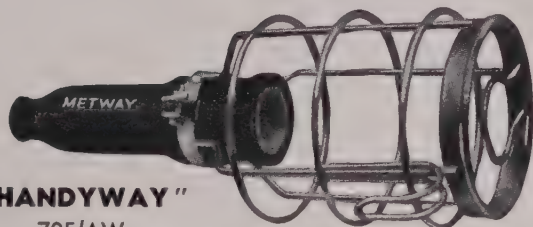
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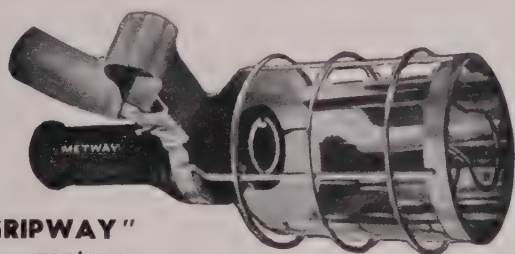


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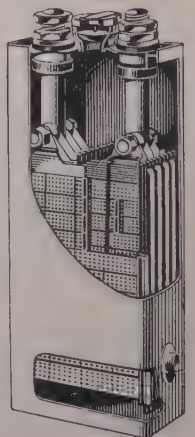
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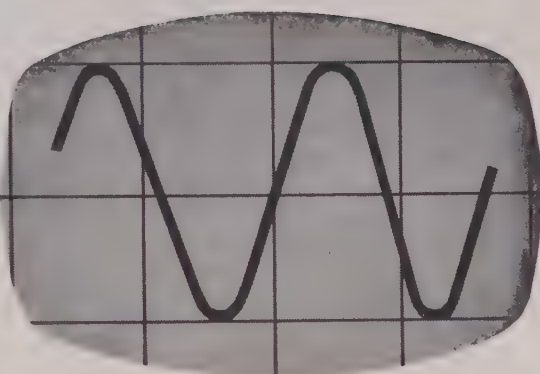
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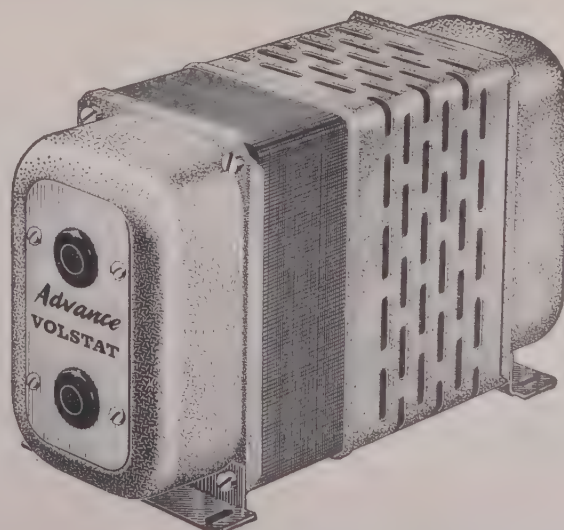
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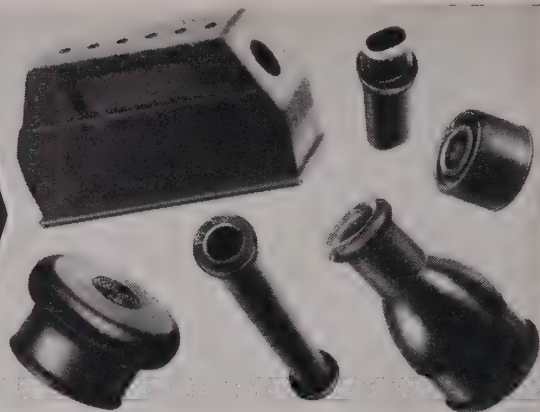
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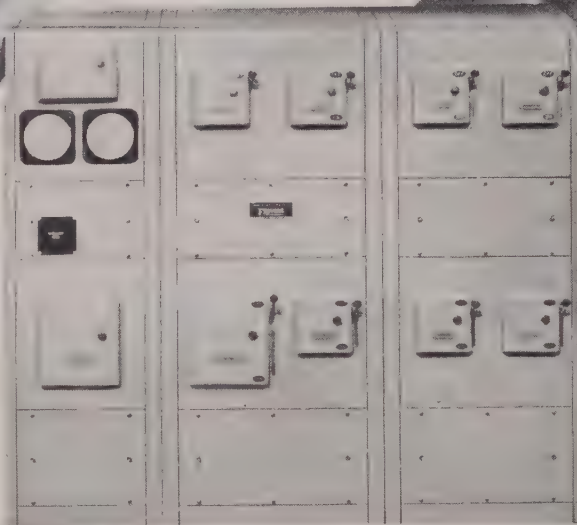
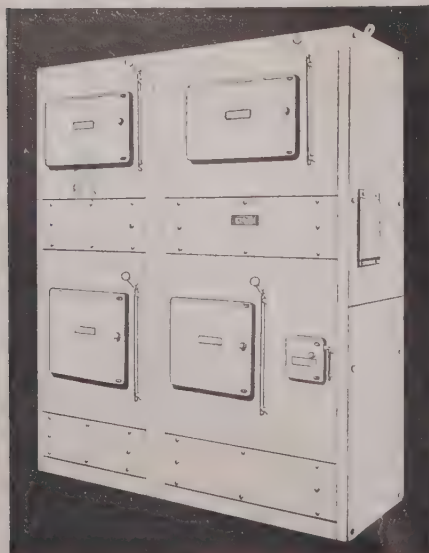
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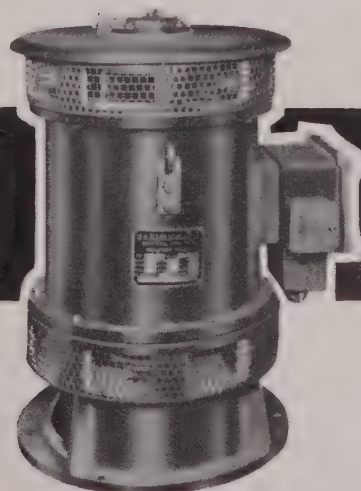
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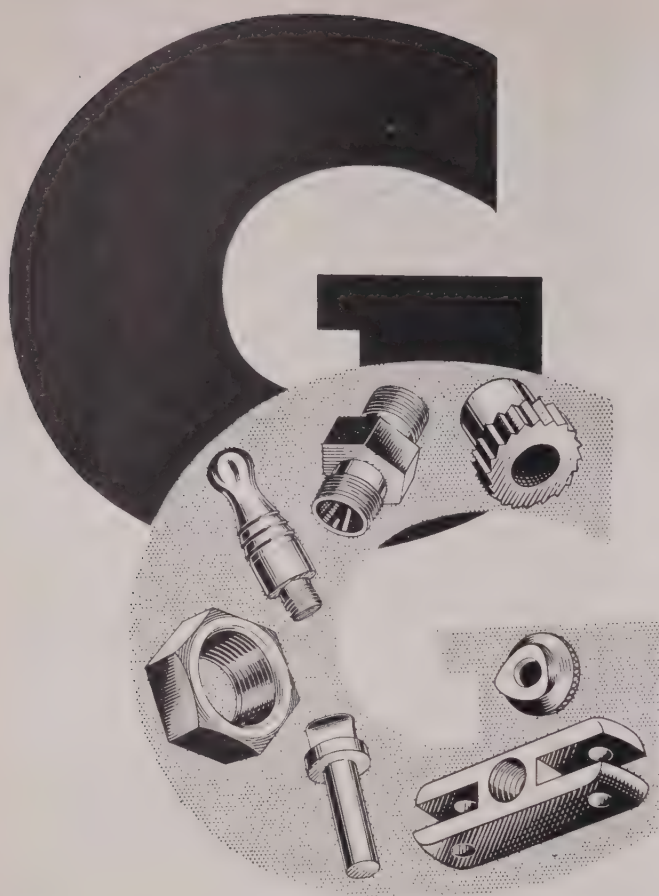
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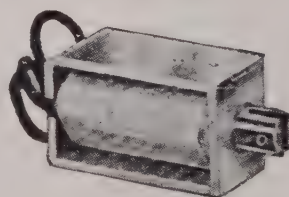
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**Call your freight agent,
or Clipper Cargo at:**

LONDON.....	GERrard 9905
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BRADFORD.....	BRAdford 31717
GLASGOW.....	CITy 5744

PAN AMERICAN

FASTEST DELIVERY TO ALL THE WORLD

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By Appointment to
Her Majesty The Queen
Manufacturers of Electric Lamps
Crompton Parkinson Ltd

NEW!

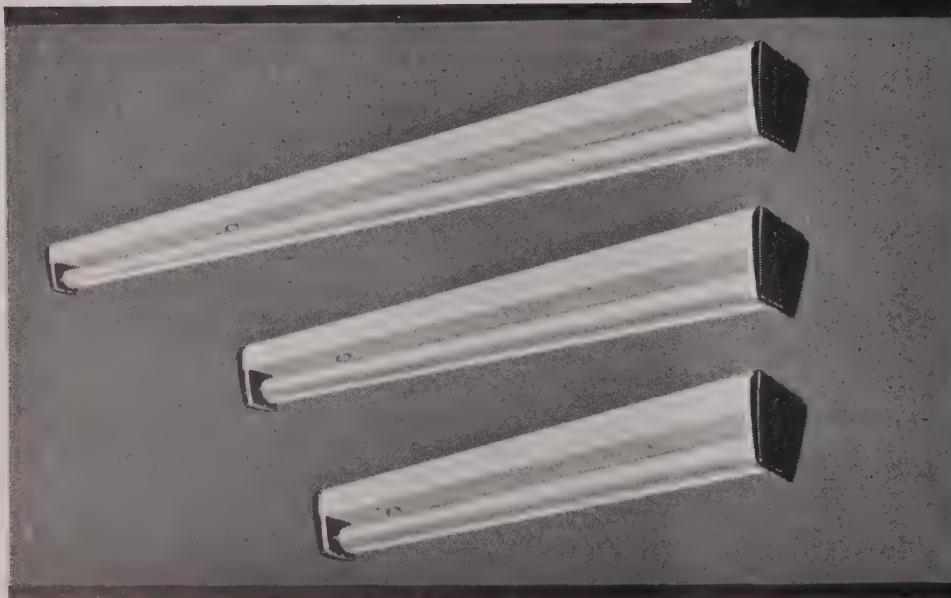
Winners in every size!

Crompton Crompack

FLUORESCENT FITTINGS

8' · 5' · 4'

230v / 250v



CROMPACKS

Are packed complete with high-output Crompton Warm White tubes and are fitted with full-size efficient control gear to B.S.2818.

ATTACHMENTS

Include reflectors of metal and colour-fast 'Diakon'—'Diakon' diffusers—scintillating glass panels—opal plastic dishes—plastic louvres, all of which are simply attachable to the Crompack.

STUDY THEIR FORM

CHANNEL Enclosed at the top to exclude dust.

LAMP HOLDERS Bi-pin, spring-loaded: cover and protect ends.

CONTROL GEAR Low loss, cuts load and current costs.

STARTER SWITCHES Easily accessible.

FINISH Long-lasting tough white enamel.

FIXINGS For conduit, chain, or direct to ceilings and walls.

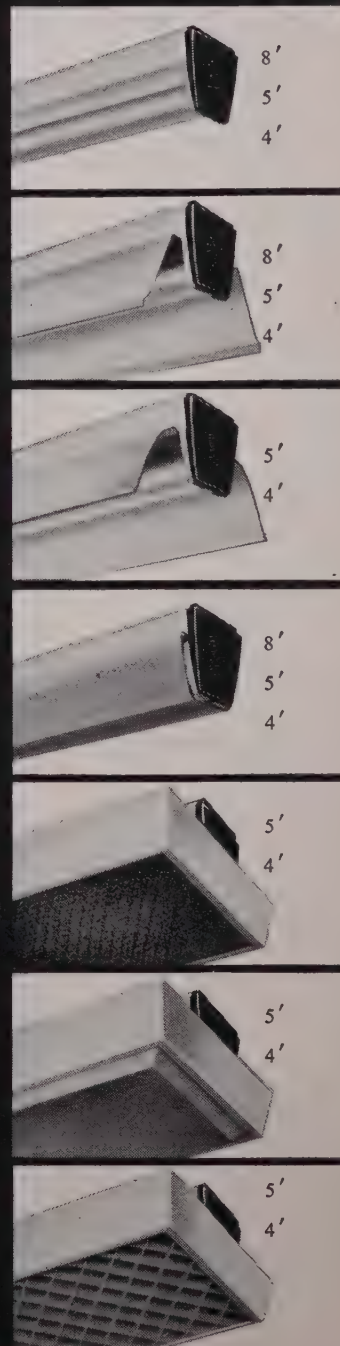
COSTS Initial cost LOW

Installation cost LOW

Running cost LOW

Maintenance cost LOW

PERFORMANCE HIGH



Crompton Crompack

WINNERS ON LOOKS, PERFORMANCE and FINISH

Write for brochure to:

CROMPTON PARKINSON LTD., CROMPTON HOUSE, ALDWYCH, LONDON, W.C.2.

Classified Advertisements

CLASSIFIED advertisements are PREPAID at 4/- per line (approx. 6 words).

DISPLAYED CLASSIFIED:—53/- per single column inch.

Where an advertisement includes a Box Number there is an additional charge of 1/-.

SERIES DISCOUNTS for consecutive insertions:—13, 5%; 26, 10%; 52, 15%.

SITUATIONS WANTED:—Three insertions under this heading can be obtained for the price of two if ordered and prepaid with the first insertion.

Remittances payable to "ELECTRICAL REVIEW."

REPLIES TO BOX NUMBERS should be addressed to the Box Number in the advertisement, c/o ELECTRICAL REVIEW, Dorset House, Stamford Street, London, S.E.1. If an applicant for a situation appearing under a Box Number does not wish his reply to be forwarded to a particular firm or individual, instructions to this effect should be addressed to the Advertisement Supervisor, ELECTRICAL REVIEW. The name of an advertiser using a Box Number cannot be disclosed.

OFFICIAL NOTICES, TENDERS, ETC.

COUNTY COUNCIL OF THE COUNTY OF LANARK

Trunk Roads Lighting Extensions

1. BRAIDWOOD A.73
2. MUIRHEAD A.80

1. 15 140-watt Sodium Discharge Lanterns, totally enclosed and suitable for housing auxiliary gear; lanterns to be supplied fitted with auxiliary gear.

2 (a). 13 Heavy type Steel Street Lighting Columns, suitable for overhead lines.

(b). 14 Steel Outreach Bracket Arms.

Tenders will be considered for the whole or any portion of the works and the County Council does not bind itself to accept the lowest or any tender.

Manufacturers desirous of tendering should make application for the tender documents to the Assistant Engineer (Lighting), 23, Beckford Street, Hamilton.

Tenders will not be considered unless enclosed in a plain sealed envelope endorsed "Trunk Road Lighting," and must be delivered to the Assistant Engineering (Lighting), at the above address, not later than 10 a.m. on Friday, 24th March, 1961.

IAN V. PATERSON,
County Clerk. 7958

CITY OF HEREFORD

Electrical Installation to

- (a) 5 Bungalows and Garages, Home Lane
- (b) 12 Bungalows and Garages, Hillside Avenue

TENDERS are invited for the wiring for electricity to 17 bungalows with garages on two adjoining sites as above.

Plans, specifications and forms of tender may be obtained from the City Architect, Town Hall, Hereford, upon deposit of £1 (returnable following the submission of a bona fide tender and return of all documents).

SEPARATE TENDERS for each site should be returned in the envelope provided and endorsed "Electrical Installation, Bungalows, Home Lane and Hillside Avenue," to reach the undersigned not later than 12 noon on Monday, the 20th day of March, 1961.

J. A. WESTON,
Town Clerk. 7956

GHANA SUPPLY COMMISSION TENDER FOR SUPPLY OF PVC INSULATED CADMIUM COPPER WIRE AND HARD DRAWN COPPER WIRE

THE GHANA SUPPLY COMMISSION invite manufacturers to apply for tender for the supply of the following:—

Ref. PAT 4082/1 Description:

- (a) 66,000 yards of PVC Insulated Cadmium Copper Wire.

- (b) 34½ tons Bare Hard Drawn Copper Wire.

Forms of tender and conditions of contract will be obtainable from the 15th March, 1961, on payment of a fee of £1 from the Secretary, Ghana Supply Commission, P.O. Box M.35, Accra, Ghana.

Forms of tender will not be issued after the 5th April, 1961. The closing date for receipt of tenders will be 12th April, 1961. 7910

BOLTON AND DISTRICT JOINT SEWERAGE BOARD

Ringley Fold Sewage Treatment Works

THE Board is preparing a selected list of contractors from whom tenders will be invited for the electrical work associated with the above scheme. The work will be divided into six separate contracts, namely:—

1. 415-volt air break switchgear.
2. 415-volt contactor gear.
3. Works instrument panel.
4. Road and floodlighting columns and equipment.
5. Private automatic telephone exchange.
6. Main and auxiliary cables.

Firms should apply to the Board's Consulting Electrical Engineers, Messrs. Kennedy & Donkin, 64, Royal Exchange, Cross Street, Manchester, 2, by Monday, 20th March, 1961, stating the contracts for which they wish to be considered.

PHILIP S. RENNISON,
Clerk and Solicitor to the Board. 7955

COUNTY BOROUGH OF BLACKPOOL

TENDERS invited for the supply of the following equipment for the Lighting and Electrical Services Department:—

- 120 Medium Class Tubular Steel Poles.
- 135 Fibreglass Bases and Collars for Steel Poles.
- 155 Group A Post-top Fluorescent Lanterns.
- 120 Cast Iron Spigots incl. Connecting Box.
- 165 Synchronous Solar Dial Time Switches.
- 32 Special Group A Concrete Columns.

Specification, drawings, tender and general conditions from Director of Lighting and Electrical Services, Rigby Road East, Blackpool, to be returned by 10 a.m., 20th March, 1961. 7959

METROPOLITAN BOROUGH OF WANDSWORTH

Electrical Works

APPLICATIONS invited from those who desire to have their names placed on the Council's list of electrical contractors who may be invited to submit quotations or tenders from time to time for the execution of electrical installation works.

Applications by letter giving names of two technical and one financial referee to reach me by 30th March, 1961.

J. NOEL MARTIN,
Municipal Buildings,
Wandsworth,
London, S.W.18. 7957

DURHAM COUNTY COUNCIL

TENDERS invited:—

Staindrop New Modern School: Electrical Installation.

Application for further details to County Architect, South Street, Durham, not later than 22nd March, 1961.

J. K. HOPE,
Shire Hall, Durham. 7988

CLASSIFIED ADVERTISEMENTS ARE PREPAID

Advertisements are accepted up to first post on Monday of the week of issue

If blocks, bold type or ruled borders are required then on Friday prior to week of issue

All communications to be addressed to: Classified Advertisement Department, ELECTRICAL REVIEW Dorset House, Stamford Street London, S.E.1

Original testimonials should not be sent with applications for employment

SITUATIONS VACANT

(See "Replies to Box Numbers" above)



MIDLANDS ELECTRICITY BOARD

SECOND ASSISTANT ENGINEER required in the Stroud District of the Central Gloucestershire Sub-Area.

Experience necessary in all branches of distribution work including construction, maintenance and operation of high and low-voltage systems and substations, and the planning of system reinforcements and mains extensions. Technical qualifications desirable.

Salary £1,040/£1,165 per annum (N.J.B. Grade F.7). Superannuable.

Apply by letter within 14 days, stating age, experience, present position and salary, to Mr. S. Raybould, Sub-Area Manager, Midlands Electricity Board, Eastern Avenue, Gloucester.

F. W. CATER,
Secretary. 7974

ELECTRONIC ENGINEER

MAWDSLEY'S LTD., OF GLOUCESTERSHIRE, manufacturers of special-purpose rotating electrical machinery, wish to employ a young qualified (e.g., Degree or H.N.C. (E.), with Electronic Endorsement) **ELECTRONIC ENGINEER** on development work in their Experimental Department, and to maintain liaison with an associated company on the development and application of electronic control equipment. Experience in electronics and/or light current engineering essential.

An adequate salary will be paid to the right man; the company has a good pension and life assurance scheme.

Applications will be treated in strictest confidence and should be sent to the

Managing Director
MAWDSLEY'S LTD.
Dursley, Glos. 7979

FOSTER TRANSFORMERS LTD. South Wimbledon, London, S.W.19

require **TEST ENGINEER** with good electrical background not necessarily on power transformers.

Apply to the Personnel Officer stating age and previous experience. 7864

Situations Vacant (continued)**SOUTH WESTERN ELECTRICITY BOARD**

THIRD ASSISTANT DISTRICT ENGINEER (Operation and Maintenance), West Cornwall (Camborne).

Salary within Class G, Grade 9, Salary Scale 7, £965 to £1,090 per annum of the N.J.B. Agreement.

The successful candidate will be responsible to the First Assistant District Engineer (Operation and Maintenance) and will be required to undertake general duties on the maintenance of the EHV, HV and LV networks and will be expected to undertake standby duties.

Previous experience and qualifications leading to the Higher National Certificate in Electrical Engineering will be an advantage and the possession of a current driving licence is desirable.

Applications to be made on standard form AE6/ACT OBTAINABLE BY POSTCARD ONLY from the District Manager, South Western Electricity Board, 13, Basset Road, Camborne. Closing date for receipt of completed applications is 25th March, 1961.

FOURTH ASSISTANT ENGINEER

(Drawing Office),

Chief Engineer's Department, Head Office, Bristol.

Salary within Class AX, Grade 10, Salary Scale 8, £935 to £1,165 per annum of the N.J.B. Agreement.

The duties of the successful candidate will include the design and preparation of drawings in connection with outdoor switching stations at 132/33kV bulk supply points and all necessary estimates and material schedules; the design and preparation of drawings of reinforced concrete structures for this equipment; preparation of load flow, protection and system diagrams and engineering reports. He will also be required to supervise a section in the drawing office and instruct apprentice engineering draughtsmen.

Applicants should be in possession of the Higher National Certificate in Electrical Engineering or equivalent qualification.

Applications to be made on standard form AE6/ACT OBTAINABLE BY POSTCARD ONLY from the Establishments Officer, South Western Electricity Board, Electricity House, Colston Avenue, Bristol, 1. Closing date for receipt of completed applications is 25th March, 1961.

GENERAL ASSISTANT DISTRICT

ENGINEER (Commercial Development), Bristol Central (Commercial) District.

Salary within Class K, Grade 14, Salary Scale 5, £825 to £940 per annum of the N.J.B. Agreement.

The duties associated with this position will be in connection with the development of the large commercial and industrial potential of the District. Satisfactory performance of these duties will necessitate the successful candidate possessing or acquiring a sound knowledge of electrical installations and I.E.E. and Factory Regulations; he will be required to estimate for electrical installations in factories, offices and shops, and to advise consumers on installation work, including tariffs and costs.

An engineering background is essential, and whilst commercial experience would be an advantage, consideration will be given to those engineering applicants with an aptitude for commercial work but without actual commercial experience.

Possession of appropriate technical qualifications at least equivalent to the Ordinary National Certificate in Electrical Engineering is desirable.

Applications to be made on standard form AE6/ACT OBTAINABLE BY POSTCARD ONLY from the Manager, Bristol Central (Commercial) District, South Western Electricity Board, Electricity House, Colston Avenue, Bristol, 1. Closing date for receipt of completed applications is 25th March, 1961.

GENERAL ASSISTANT DISTRICT

COMMERCIAL ENGINEER, Bristol East (Commercial) District.

Salary within Class K, Grade 14, Salary Scale 5, £825 to £940 per annum of the N.J.B. Agreement.

The successful candidate's duties will be concerned with the development of the industrial, commercial and domestic potential of the District.

This will include the preparation of plans and estimates for electrical installations in all types of premises with particular reference to space and storage heating systems. This will entail

liaison with sales representatives and advising consumers on installation costs and tariffs.

An engineering background is desirable and candidates must have experience of electrical installation work, and a sound knowledge of Factories Acts, and I.E.E. and similar Regulations. Whilst a commercial background would be an advantage, consideration will be given to those applicants with practical experience and an aptitude for commercial work.

Possession of appropriate technical qualifications at least equivalent to the Ordinary National Certificate in Electrical Engineering is desirable.

Applications to be made on standard form AE6/ACT OBTAINABLE BY POSTCARD ONLY from the Manager, Bristol East (Commercial) District, South Western Electricity Board, 70, Overhill Road, Downend, Bristol. Closing date for receipt of completed applications is 25th March, 1961.

SALES ENGINEER**Scotland**

AN English company, with a long tradition in the design and manufacture of electrical plant for the industrial and marine markets, wishes to appoint a SALES ENGINEER as sole representative for Scotland.

Applicants should be Degree/H.N.C. standard, works trained in rotating machines, experienced in project engineering, and must have a successful sales record in the electrical industry, at least partially in Scotland. A good salary will be paid for the right man.

No reference will be made to present or past employers without an applicant's express permission. Applications should therefore include full details, and should be sent to the Personnel Manager.—Box 7921.

AEI

Associated Electrical Industries Limited ENGINEERS AND DRAUGHTSMEN

Vacancies have arisen for professional engineers and draughtsmen in the electrical branch of Works Engineers Department, as a result of expansion and reorganisation. These posts will prove attractive to men who seek scope for initiative, original thought and the exercise of responsibility. The work of the department is varied in scope and will in many cases, present a worthwhile challenge.

Salaries will be commensurate with age and qualifications.

Appointments will be made to:—

WORKS ENGINEERING SECTION—which deals with the preparation of estimates and the supervision of contracting work in the electrical field and also organising and maintaining the Works electricity supply and distribution system on the 33 kV, 11 kV, 6.6 kV and 440-volt network.

TEST ENGINEERING SECTION—which has been set up to deal primarily with the engineering and maintenance of a large variety of test departments installations for generators, transformers, motors, relays, electronic and other equipment.

For the engineering appointments the minimum professional qualifications will be H.N.C. although A.M.I.E.E. or its equivalent would be preferred, particularly for the test engineering section. Each applicant should have served a recognised apprenticeship and experience in one of the following would be a recommendation: design of electrical installations for factories, protective gear applications, electronics applications, control gear applications, electrical contracting work, precision instrumentation, heavy plant testing.

For draughtsmen, the minimum qualifications are O.N.C. together with experience in at least one of the following: wiring diagrams, wiring layouts, electrical equipment layouts.

Please send brief details of your career, and the type of post in which you are interested to:—

Personnel Manager (V.18)

Associated Electrical Industries (Manchester) Ltd.

Trafford Park, Manchester, 17

7954

CENTRAL ELECTRICITY GENERATING BOARD

Assistant Engineers

required in Regional Offices of the Production, Inspection and Test Section of the Services Branch.

(a) ASSISTANT ENGINEER (Mechanical), Leeds Office.

Salary within scale £1,400-£1,830 p.a.

(b) ASSISTANT ENGINEER (Mechanical), Manchester Office.

Salary within scale £1,285-£1,610 p.a.

The section is concerned with the production, inspection and testing in manufacturers' works of mechanical and electrical plant and equipment required for generation (including nuclear) and transmission purposes.

Candidates should preferably have qualifications equivalent to Corporate Membership for appointment (a) and Graduate Membership for appointment (b) of the Institution of Mechanical Engineers. Recent experience in production control methods and inspection and testing of plant in manufacturers' works is desirable.

Applications stating age, qualifications, experience, present position and salary, and indicating post applied for, to the Appointments Officer, 24/30, Holborn, London, E.C.1, by 27th March. Envelopes should be marked "Confidential, Ref. ER/115." 8008

THE COLNE VALLEY WATER COMPANY

require a MAINTENANCE ELECTRICIAN. Permanent pensionable appointment. 42-hour, 5-day week. House available.

Applications should be addressed to:—

John Christie, B.Sc., M.I.C.E., M.I.W.E.

Chief Engineer

THE COLNE VALLEY WATER COMPANY

Aldenharn Road

Watford, Herts.

8005

A LEADING Domestic Appliance Manufacturer in North-East London has vacancies for Graduates and Laboratory Assistants.

Salaries commensurate with age and experience.

PROGRESSIVE APPOINTMENT

GOOD CONDITIONS

Write giving details of age, experience and salary required to Box 3927, c/o Charles Barker & Sons Limited, Gateway House, London, E.C.4.

7951

POWER HOUSE ENGINEERS

required by Air Ministry for 2-year tour in Aden under contract; some family accommodation available for married men. Starting salary is according to age, qualifications and experience and ranges from £743 at age 22 to £909 at age 28 or over, rising to max. of £1,014. Tax free foreign service allowance in addition to salary varies according to marital status and whether or not official accommodation is occupied, viz.:—

Single :—

Accommodated £200 p.a.

Unaccommodated £455 p.a.

Married :—

Accompanied and in official accommodation £755 p.a.

Accompanied and in private accommodation £1,190 p.a. and excess rent.

Unaccompanied and in private accommodation £815-£855 p.a.

Unaccompanied and in official accommodation £560 p.a.

Kit allowance and free passage overseas, also free passages for family, when private or official accommodation arranged. Free medical and educational arrangements and good sports facilities. 5-day week with 18 days' paid annual leave. Paid sick leave within certain limits.

Candidates must have had indentured apprenticeship of not less than 3 years, served preferably with a manufacturer of diesel engines of 300-2,000 b.h.p. Also not less than 5 years' experience following apprenticeship, at least 2 years of which should have been in a power house containing diesel engine-driven alternators. Experience of parallel running of alternators and of planned maintenance of power house plant would be an advantage. Preference given to candidates holding O.N.C. (Mech.) or equivalent.

Applicants, who must be natural-born British subjects, should write stating age, qualifications and experience to Manager (PE.520), Ministry of Labour, Professional and Executive Register, Atlantic House, Farringdon St., London, E.C.4. Selection will be by interview in London and some expenses entailed will be reimbursed.

268

YORKSHIRE ELECTRICITY BOARD

No. 3 (Sheffield) Sub-Area

FOURTH ASSISTANT ENGINEER
(OPERATION AND MAINTENANCE).

Applicants should have had experience in the operation of high voltage systems. The successful candidate will be required to take part in a rota of shift duties covering the Sheffield City network.

Salary N.J.B. Class N, Grade 13 (Scale 9), plus 10% shift enhancement, £1,226 10s./£1,369 10s. per annum.

Applications, together with the names of two referees, should be sent to the Manager, No. 3 (Sheffield) Sub-Area, Yorkshire Electricity Board, Commercial Street, Sheffield, 1, not later than 24th March, 1961.

No. 7 (Grimsby) Sub-Area

GRIMSBY DISTRICT
THIRD ASSISTANT DISTRICT
ENGINEER.

Applicants should be of Higher National Certificate Standard in Electrical Engineering and have experience in the design, construction, operation and maintenance of H.V. and L.V. overhead and underground distribution systems, substation plant and ancillary equipment.

Salary N.J.B. Class H, Grade 9, Scale 8, £1,040/£1,25/£1,165 per annum.

GAINSBOROUGH DISTRICT
SECOND ASSISTANT DISTRICT
ENGINEER.

Applicants should preferably be Corporate Members of the Institution of Electrical Engineers or hold an equivalent qualification. They must have had a sound training and extensive experience in the design, construction, operation and maintenance of H.V. and L.V. overhead and underground distribution systems in rural and urban areas, substation plant and ancillary equipment.

Salary N.J.B. Class E, Grade 7 (Scale 7), £965/£1,090 per annum.

Applications, together with the names of two referees, should be sent to the Manager, No. 7 (Grimsby) Sub-Area, Yorkshire Electricity Board, Moss Road, Grimsby, not later than 24th March, 1961.

7989

ADMIRALTY REQUIRES EXPERIENCED MECHANICAL ELECTRICAL AND ELECTRONIC ENGINEERS

Experienced Senior Production Engineers and Production Engineers required in various Admiralty Establishments, mainly in Bath, Portsmouth, Sheffield and Beith (Ayrshire) Areas. Duties cover variously Marine, Mechanical and Electrical/Electronic equipment including Guided Missiles and Radar. In particular, two Senior Production Engineers are required at Sheffield and one at Beith. At Sheffield, one post is in charge of the design of gauges, including electronic equipment for measuring and testing armament stores; the other post is in charge of manufacture of gauges and general factory production, including plant maintenance, etc. The post at Beith is to organise and advise staff engaged in testing and assembly of Guided Missiles, resolving technical problems, and designing special test equipment.

Qualifications. Candidates must be of British birth and have served a recognised apprenticeship or had equivalent training and possess University Degree, A.M.I.Mech.E., A.M.I.E.E. or exempting qualifications. Opportunities occur to gain establishment.

Salary (National Rates)	Senior Production Engineers	£1456 to £1950
	Production Engineers	£936 to £1429

Applications. Apply stating age, training, experience and qualifications to the Secretary of the Admiralty; C.E.II (88) Empire Hotel, Bath, quoting PE.6117.

7941

BRUSH

BRUSH ELECTRICAL ENGINEERING COMPANY LIMITED
LOUGHBOROUGH, LEICESTERSHIRE
(A member of the Hawker Siddeley Group)

SALES DIVISION

TENDERING AND CONTRACTS
ENGINEERS

Applications are invited from suitably qualified men who wish to work in one of the following fields:—

ROTATING ELECTRICAL MACHINES
SWITCHGEAR

Attractive salaries (according to age and experience) will be paid, and in appropriate cases assistance with housing and removal expenses can be considered.

Applications, WHICH WILL BE TREATED IN THE STRICTEST CONFIDENCE, should give details of qualifications and experience and be addressed to:—

Mr. A. Garner

BRUSH ELECTRICAL ENGINEERING COMPANY LIMITED
Loughborough, Leicestershire
quoting reference : PL.9927

7982

THE BARBADOS LIGHT AND POWER COMPANY LIMITED

Vacancy for Shift Charge Engineer

THE BARBADOS LIGHT AND POWER COMPANY LIMITED has a vacancy for a SHIFT CHARGE ENGINEER at its Generating Station at Bridgetown, Barbados.

Applicants should have experience in the operation of modern steam turbines, water tube boilers and diesel generators, and must have Graduate Membership of the I.E.E. or I.Mech.E. or Associate Membership of the I.Mar.E. or the Higher National Certificate in Mechanical or Electrical Engineering or Second Engineer's M.O.T. Diesel and Steam Certificate or R.N. equivalent.

The annual salary is £1,000 plus 20% Bonus, rising by annual increments of £40 plus 20% Bonus. Rent free furnished accommodation is provided and successful applicants will be included in the non-contributory pension and insurance scheme and will qualify for medical attention.

First class passages to Barbados will be provided for the successful applicant, his wife and two children up to the age of 16. First class leave passages to the United Kingdom will be provided every three years. Information on Barbados can be obtained from the West India Committee, 40 Norfolk Street, London, W.C.2.

Applications giving full details of qualifications, age, experience, etc. together with copies of two recent testimonials, should be sent to

The Secretary
The Barbados Light & Power Co. Ltd.
3 London Wall Buildings, London, E.C.2

7944

Situations Vacant (continued)

LONDON ELECTRICITY BOARD

Assistant Distribution Engineers

VACANCIES for ASSISTANT DISTRIBUTION ENGINEERS exist in the under-noted Districts. Applications stating age, qualifications and experience should be sent direct to the Manager of the District concerned, quoting the appropriate reference number.

Applicants should have a sound technical education to the standard of the Higher National Certificate and possess practical experience of all branches of engineering work associated with the organisation of a District distribution department.

The posts are graded under Schedule A of the National Joint Board Agreement as Class H. The salary figures quoted are inclusive of London allowance.

EAST END DISTRICT.

255/279, Cambridge Heath Road, E.2
(Ref. PER/V/3197/R).

Salary Grade 9, £1,090/£1,215 per annum.

WESTERN DISTRICT.

154, Uxbridge Road, W.12
(Ref. PER/V/3223/R).

Salary Grade 9, £1,090/£1,215 per annum.

BOROUGH DISTRICT.

15, Penrose Street, S.E.17
(Ref. PER/V/3203/R).

Salary Grade 11, £940/£1,065 per annum.

SOUTH EASTERN DISTRICT.

44, Powis Street, S.E.18
(Ref. PER/V/3206/R).

Salary Grade 11, £940/£1,065 per annum.

7962

BRUSH

BRUSH ELECTRICAL ENGINEERING COMPANY LIMITED
LOUGHBOROUGH, LEICESTERSHIRE

(A member of the Hawker Siddeley Group)

MECHANICAL AND ELECTRICAL DRAUGHTSMEN

Applications are invited from suitably qualified men who have had experience of the following type of work:—

L.T. AND H.T. SWITCHGEAR (including circuitry)

ROTATING ELECTRICAL MACHINES (200 to 5,000 k.w.)

TRANSFORMERS

MOTOR CONTROL GEAR

GENERAL ENGINEERING

DIESEL-ELECTRIC LOCOMOTIVES

Attractive salaries (according to age and experience) will be paid, and in appropriate cases assistance with housing and removal expenses can be considered.

Applications, WHICH WILL BE TREATED IN THE STRICTEST CONFIDENCE, should give details of qualifications and experience and be addressed to:—

Mr. A. Garner

BRUSH ELECTRICAL ENGINEERING COMPANY LIMITED

Loughborough, Leicestershire

quoting reference: PL.9926

7983

COMMONWEALTH



OF AUSTRALIA

WEAPONS RESEARCH ESTABLISHMENT

ELECTRICAL AND ELECTRONIC ENGINEERS

The Department of Supply invite applications for the following vacancies at the Weapons Research Establishment, Salisbury, near Adelaide, and at Woomera, South Australia:—

AT WOOMERA

POSITION ENGINEER GRADE 3
AND SALARY: £1,730/1,950 (Australian currency)

DUTIES: (Position No. 25).—Responsible for the installation and maintenance of electrical plant and equipment including generators, motors, frequency converters, electrical switch and control gear.

DUTIES: (Position No. 34).—Responsible for the installation and maintenance of electrical plant and equipment including generators, motors, frequency converters, electrical switch and control gear. Supervise operation and maintenance of diesel power stations up to 1,500 k.w.

POSITION ENGINEER GRADE 1
AND SALARY: £1,235/1,620 (Australian currency)

DUTIES: (Position No. 5).—Under supervision, control the electrical work performed by the group workshops and prepare maintenance schedules and testing procedures for electrical installations.

AT SALISBURY

POSITION ENGINEER GRADE 3
AND SALARY: £1,730/1,950 (Australian currency)

DUTIES: (Position No. 105).—Responsible to a Senior Engineer for the control of a section of the electrical workshop engaged on installation and maintenance of light electrical equipment such as motors, mobile alternators, frequency changers, special power supplies, refrigeration and airconditioning plant.

DUTIES: (Position No. 223).—Responsible for the design of electrical circuits and light electro-mechanical equipment in the fields of doppler, telemetry, timing or computers.

POSITION ENGINEER GRADE 1
AND SALARY: £1,235/1,620 (Australian currency)

DUTIES: (Position No. 232).—Under direction, undertake design of electronic circuits and light electro-mechanical equipment in the fields of doppler, telemetry, timing or computers.

QUALIFICATIONS (All positions).—Degree in Mechanical, Electronic or Electrical Engineering or equivalent qualifications giving full exemption from the Corporate membership examinations of I.E.E. or I.Mech.E. Experience relative to the appropriate duties, an advantage.

HOUSING: Married accommodation will be made available.

ALLOWANCES: A special allowance for Woomera allocations are £120 per annum for a married man maintaining a family; others £70 per annum.

TRAVEL: Under certain conditions, first class sea or air fares (if first class available) for the successful candidates and dependants (wife and dependent children) will be paid by the Commonwealth.

CONTRACTS: For certain positions contract employment may be considered. Full details on application.

APPLICATIONS: Forms obtainable from the Senior Representative (AV.103/5), Department of Supply, Australia House, Strand, London, W.C.2, with whom completed applications should be lodged by 29th March, 1961.

7963

ASSISTANT ELECTRICAL ENGINEER

APPLICATIONS are invited from men in the age range 26-32, who are Graduates of the Institution of Electrical Engineers. Experience of modern techniques of electrical installation in large factories, including substations and cable work, is desirable. A knowledge of industrial illumination would be valuable.

This is an interesting and responsible appointment in the head office of a large and expanding company. The appointment will be based in rural Monmouthshire, but will include visits to all the company's factories. For married applicants unfurnished houses would be available to rent, and the company offers assistance in defraying removal expenses.

Please apply in writing, quoting reference E/20, to:—

The Personnel Manager

BRITISH NYLON SPINNERS LIMITED

Pontypool, Mon.

7980

CENTRAL ELECTRICITY GENERATING BOARD

Eastern Division

APPLICATIONS are invited for the following appointment at WEST THURROCK GENERATING STATION (Essex):—

MAINTENANCE ENGINEER
(Instruments)

(S.V. No. 1452).

Salary range £1,595-£1,780 per annum, inclusive of London weighting.

Applicants should have had a wide experience in instrument maintenance and a sound working knowledge of industrial electronics.

Corporate membership of a recognised engineering or electronic institution would be an advantage.

Applications, quoting reference S.V. No. 1452, stating age, qualifications, experience and present position, should be sent to the Controller, Central Electricity Generating Board, Eastern Division, West Farm Place, Chalk Lane, Cockfosters, Barnet, Herts., to arrive not later than 18th March, 1961.

7939

CENTRAL ELECTRICITY GENERATING BOARD

Midlands Division

APPPLICATIONS are invited for the position of **EFFICIENCY ENGINEER** at Rugeley Power Station. Salary in accordance with Class L, Grade 6 (£1,535-£1,720 per annum) of the National Joint Board Agreement.

Applicants should have held a position of responsibility in a modern power station and should have had a thorough practical and theoretical training. Preference will be given to candidates who are Associate Members of the Institution of Mechanical or Electrical Engineers or hold qualifications leading to associate membership, and who have had experience of plant efficiency control and routine testing procedures.

Apply, quoting vacancy number 48/61 MD, on form AE6 available from the Station Superintendent, Rugeley Power Station, Rugeley, Staffs. Closing date for receipt of applications, 20th March, 1961.

Applications are invited for two positions of **ASSISTANT ENGINEER (Operation)** at Rugeley Power Station. Salary will be in accordance with Class L, Grade 10, £1,190-£1,325 per annum of the National Joint Board Agreement.

Applicants should possess a Higher National Certificate or equivalent qualifications and have had operation experience in a modern power station. Experience of pulverised fuel firing would be an advantage. The successful applicants will be required to act as reliefs for Assistant Shift Charge Engineers and will then be entitled to the appropriate grade and shift enhancement.

Apply, quoting vacancy number 49/61 MD, on form AE6 available from the Station Superintendent, Rugeley Power Station, Rugeley, Staffs. Closing date for receipt of applications, 20th March, 1961.

ASSISTANT ENGINEERS are required at Ironbridge Power Station. N.J.B. service conditions, superannuable appointment, salary within Schedule A, Grade J.12, £890-£1,015 per annum. These engineers will be expected to carry out shift relief duties and when not so employed will be available to undertake duties in the maintenance and operation departments.

Shift allowance as laid down in the N.J.B. Agreement will be paid when shift duties are worked.

Applicants should have received a sound technical training and should preferably have had experience in the control of a works supply system. Appropriate technical qualifications will be an advantage.

Apply, quoting vacancy number 44/61 MD, on form AE6 available from the Station Superintendent, Ironbridge Power Station, Buildwas, Salop, to whom they should be returned when completed not later than 20th March, 1961.

GENERAL ASSISTANT ENGINEER is required at Ironbridge Power Station for generation operational duties. N.J.B. service conditions, superannuable appointment, salary within Schedule A, J.14, £765-£870 per annum; a shift enhancement of £90 will be paid when engaged on shift duties.

Applicants should have received a sound technical training and preferably have had some industrial engineering experience, and have as a minimum qualification the Ordinary National Certificate.

Apply, quoting vacancy number 43/61 MD, on form AE6 available from the Station Superintendent, Ironbridge Power Station, Buildwas, Salop, to whom they should be returned when completed not later than 20th March, 1961.

THIRD ASSISTANT ENGINEER (Control) required for shift duties at the Birmingham Grid Control Centre. N.J.B. service conditions, superannuable appointment, salary within Schedule B, Class CX, Grade 8, Scale 12, £1,105-£1,500 per annum, plus 10% shift allowance.

Applicants should have received a sound education and basic training, with subsequent experience in the electricity supply industry, preferably in power stations. Applicants should have H.N.C. or equivalent qualifications. Successful applicants will be required to assist the Control Engineer in all functions necessary for the proper control of a large portion of the grid system.

Apply, quoting vacancy number 45/61 MD, on form AE6 available from the System Operation Engineer, Warwick House, Redhill Road, West Heath, Birmingham, 31. Closing date for receipt of applications, 20th March, 1961. 7991

DOLGARROG HYDRO-ELECTRIC POWER STATION

OPERATION SUPERINTENDENT

This is the senior post at a 28 MW station on the banks of the River Conway, North Wales, where the successful candidate will be responsible to the Station Superintendent of a Group for efficient management, running, maintenance, etc. A sound practical and theoretical engineering training is required and possession of appropriate technical qualifications an advantage. Salary within range £1,115-£1,245 (E.5). Superannuable. Previous applicants need not re-apply.

Write giving full details and quoting names of two referees to Director of Labour and Welfare, CENTRAL ELECTRICITY GENERATING BOARD, 825 Wilmslow Road, Manchester 20, by 17th March, 1961. Please quote vacancy No. E.68 52/R.

7978

CENTRAL ELECTRICITY GENERATING BOARD

East Midlands Division

SHIFT CHARGE ENGINEER, LEICESTER POWER STATION (Vacancy No. 34/61).

Applications are invited for the position of **SHIFT CHARGE ENGINEER** at Leicester Power Station, Rawdykes Road, Leicester.

Applicants should preferably hold a Higher National Certificate and have had experience in a modern P.F. fired station.

Salary will be in accordance with Class G, Grade 7 (£1,115-£1,245 per annum) of the National Joint Board Agreement, plus 10% allowance for shift duties.

Closing date for receipt of applications, 17th March, 1961.

ASSISTANT PLANNING ENGINEER, CASTLE DONINGTON POWER STATION (Vacancy No. 39/61).

Applications are invited for the position of **ASSISTANT PLANNING ENGINEER** at Castle Donington Power Station, near Derby.

Applicants should have received a sound theoretical and practical training in engineering, have experience on high-merit plant, and should have a clear and objective approach to power station planning problems.

Qualifications leading to corporate membership of a senior engineering institution are desirable.

Salary will be in accordance with Class L, Grade 8 (£1,350-£1,500 per annum) of the National Joint Board Agreement.

Closing date for receipt of applications, 24th March, 1961.

ASSISTANT EFFICIENCY ENGINEER, CASTLE DONINGTON POWER STATION (Vacancy No. 40/61).

Applications are invited for the position of **ASSISTANT EFFICIENCY ENGINEER** at Castle Donington Power Station, near Derby.

Applicants should have received a sound theoretical and practical training in engineering. Experience in testing large high-merit plant would be an advantage.

Qualifications leading to corporate membership of a senior engineering institution are desirable.

Salary will be in accordance with Class L, Grade 8 (£1,350-£1,500 per annum) of the National Joint Board Agreement.

Closing date for receipt of applications, 24th March, 1961.

These appointments will be pensionable within the terms and conditions of the Electricity Supply (Staff) Superannuation Scheme.

Applications should be submitted on the official form AE6/ACT which may be obtained from the Station Superintendent and should be returned to him by the date stated.

O. S. WOODS,
Divisional Controller.
8001

BRUSH ELECTRICAL ENGINEERING COMPANY LIMITED

PROJECT ENGINEER (Electrical)

The General Engineering Division of this world famous Company has a vacancy for a fully qualified Electrical Engineer to be responsible for the planning and specifying of electrical equipment and the general technical co-ordination of comprehensive electrical installations of various types. This work will include the preparation of data so that schematic diagrams, plant layouts, etc., can be prepared for these comprehensive installations.

Applications are invited from suitably qualified men.

Applications, WHICH WILL BE TREATED IN THE STRICTEST CONFIDENCE, should give brief details of experience and qualifications, and should be addressed to

Mr. A. Garner

Brush Electrical Engineering Company Limited

Loughborough, Leicestershire

quoting reference No. PL.9923.

7965

ALUMINIUM LABORATORIES LIMITED

(The Research and Technical Organisation
of the International ALCAN
Group of Companies)

AN ELECTRICAL ENGINEER is required to work on experimental insulated aluminium cables. Applicants should have experience in the design, testing and manufacture of insulated power cables and should have suitable academic qualifications. Pension and life assurance scheme in operation.

Please apply to Personnel Officer, Aluminium Laboratories Limited, Banbury, Oxon. 7856

CHIEF ELECTRICAL ENGINEER

required for a power supply undertaking in GHANA. Minimum qualification A.M.I.E.E. Applicants should have had experience in generation and distribution up to 66 kV, preferably in senior position. Continuous contracts. Tours of 15 months with 3 months' leave on full salary. Free passages, furnished accommodation and medical attention. Provident fund operates.

Commencing basic salary £1,800 per annum.

Apply by letter stating age, full particulars of qualifications and experience, etc., to Box 631, c/o Walter Skinner Ltd., 20, Cophthall Avenue, London, E.C.2. 7961

Situations Vacant (continued)**CENTRAL ELECTRICITY
GENERATING BOARD****Assistant Engineers**

required in the Plant Design Section of the Transmission Design Branch at Headquarters, London, S.E.1.

The section comprises a number of specialist engineers concerned with the main types of transmission equipment for service voltages up to 400 kV. Their duties include the preparation of general specifications and standards, promotion and evaluation of new developments and designs for general application, their type testing and approval, and the technical assessment of tenders. The application to this work of operational experience and faults is given particular emphasis.

Applicants should have a University Degree or Higher National Certificate or equivalent qualifications leading to Corporate Membership of the I.E.E.

A. TRANSFORMER ENGINEERS.

Practical experience in design, manufacture and testing of transformers for the largest ratings and highest voltages is necessary; for a senior position this should be extensive. Specialised design knowledge of tap-changers, current limiting and shunt reactors, or voltage boosters will be an advantage.

B. SWITCHGEAR ENGINEERS.

Experience is required in one or more of the following:—

- (i) Preparation of switchgear specifications and technical assessment of tenders, with knowledge of current switchgear standards.
- (ii) Design, development and testing of circuit breakers and ancillary apparatus.
- (iii) Layout of E.H.V. substations and the design calculations involved.
- (iv) Familiarity with design features and performance of the older types of switchgear.

C. OVERHEAD LINE ENGINEERS.

Experience in the construction and maintenance of overhead lines is essential. Some experience in line design is desirable.

D. TELECOMMUNICATION ENGINEERS.

A sound training in telecommunications as applied to power systems is required. Practical experience and understanding of the Board's "Standardised System" of Telecommunications and Telemetering equipment is desirable. Duties include planning and preparation of specifications for Grid control equipment.

Salaries on scales within the following ranges according to duties and responsibilities:—

Posts A	... £1,245-£2,455 p.a.
Posts B	... £1,245-£2,010 p.a.
Posts C & D	... £1,245-£1,780 p.a.

Applications stating age, qualifications, experience, present position and salary, and indicating post applied for, to the Appointments Officer, 24/30, Holborn, London, E.C.1, by 27th March. Envelopes should be marked "Confidential, Ref. ER/116."

8009

**CENTRAL ELECTRICITY
GENERATING BOARD****North Eastern Division**

**Transmission Department:
Chargehand Linesman (Norton Section)**

CHARGEHAND LINESMAN is required for the Norton Section of the Transmission Department with headquarters at Letch Lane, Carlton, Stockton-on-Tees.

Applicants should have had a wide experience in maintenance and/or erection of overhead lines on lattice steel towers up to and including 275 kV.

Conditions of employment will be in accordance with the National Joint Industrial Council Agreement for the Electricity Supply Industry, the present rate of pay being 5s. 6½d. per hour, plus 6½d. per hour chargehand allowance per week of 42 hours.

Applications, stating age and giving full details of experience, should be sent to the Divisional Administrative Officer, Central Electricity Generating Board, North Eastern Division, Carlisle House, Newcastle upon Tyne, 1, to arrive not later than 24th March, 1961.

7953

NATIONAL INSTITUTE FOR RESEARCH IN NUCLEAR SCIENCE**E
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The National Institute for Research in Nuclear Science is constructing the Rutherford High Energy Laboratory adjacent to the Atomic Energy Research Establishment at Harwell. The Laboratory will be a centre for research into fundamental nuclear science.

The engineering organisation is expanding and professional engineers are required to work in teams responsible for the construction, installation, commissioning and subsequent operation and maintenance of experimental plant and equipment associated with a large research laboratory and covering a wide range of electrical or mechanical engineering.

Applicants should have had a sound basic training, be corporate members of the Institute of Electrical or Mechanical Engineers or hold exempting qualifications; possess a good background of engineering experience and be able to take the initiative in the development and modification to experimental plant and apparatus of a varied and original nature.

It would be an advantage for

MECHANICAL ENGINEERS

(reference No. V.N. 33/48)

to have experience in any of the following fields:—

- Metrology and the use of optical instruments for fine measurement.
- Air conditioning, water treatment, cooling and pumping plants.
- High vacuum systems and techniques.

It would be an advantage for

ELECTRICAL ENGINEERS

(reference No. V.N. 34/48)

to have experience in any of the following fields:—

- Installation, commissioning or maintenance of heavy electrical plant or large factory installations.
- Medium sized rectifier equipment, D.C. generators and associated control gear, also industrial electronics.

Salaries will be in the range £1,005-£2,090 according to age and experience. Posts are permanent and superannuable. Assistance can be given with housing.

Please send a POST CARD for further details to:—

The Recruitment Officer, Rutherford High Energy Laboratory, Harwell, Berks., quoting the reference numbers above.

7950

**BRUSH ELECTRICAL ENGINEERING
COMPANY LIMITED
LOUGHBOROUGH****ERECTION & SERVICE DEPARTMENT****SWITCHGEAR ERECTORS AND
TRANSFORMER FITTER/WIREMEN****Four OUTSIDE SWITCHGEAR ERECTORS**

are required by this Company. Applicants must be apprentice trained men and should have had experience in the erection of L.T. and H.T. Switchgear on site.

Four OUTSIDE TRANSFORMER ERECTOR/WIREMEN

are also required. Applicants must be skilled men with experience of small wiring and pyrotenax and should be prepared to assist in transformer erection.

Preference will be given to men who have a clean driving licence and are prepared to drive a van anywhere in the British Isles.

*Applications should be sent to the
Employment Officer*

**Brush Electrical Engineering Company Limited
Loughborough, Leicestershire, quoting reference PL.9925**

7964

SOUTH EASTERN ELECTRICITY BOARD

DISTRICT ENGINEER,
Gravesend District.

The appointment will be made on Grade 3, Class G, under N.J.B. conditions, at a salary of £1,440-£1,610 per annum, with progression to Grade 2 (maximum salary £1,720), subject to satisfactory service, plus London allowance.

The District is predominantly industrial but also serves a mixed urban and rural area of 37,000 consumers, and the position requires an experienced engineer, preferably Corporate Member of the Institution of Electrical Engineers, with ability to organise and control all aspects of the work of a distribution department.

Consideration will be given to a car allowance and assistance in house purchase in appropriate circumstances.

Applications, quoting ER, and naming two referees, to the District Manager, SEEBOARD, 17, Harmer Street, Gravesend, by 22nd March, 1961.

ASSISTANT DISTRICT ENGINEERS (2),
Maidstone District.

Appointment No. 1. Salary £1,040 to £1,165 per annum under N.J.B. Class F, Grade 7. Superannuable. The position requires an engineer with good technical qualifications, preferably a Graduate of the Institution of Electrical Engineers. Practical experience in the construction, operation and maintenance of underground and overhead distribution systems up to 11 kV is essential.

Appointment No. 2. Salary £890 to £1,015 under N.J.B. Class F, Grade 9. Superannuable. Applicants with an adequate technical knowledge should have a good general education and have had practical experience in general distribution work on M.V. and H.V. systems.

Applications, quoting ER, and naming two referees, to the District Manager, SEEBOARD, Fairmeadow, Maidstone, by 22nd March, 1961.

CARTOGRAPHER,

Herne Bay/Canterbury District.

Salary within range £225 to £640 p.a. according to age and experience. Superannuable. Applicants should have a good general education and experience of drawing office routine.

Applications, quoting ER, and naming two referees, to the Joint District Managers, SEEBOARD, 65, Mortimer Street, Herne Bay, by 22nd March, 1961.

CARTOGRAPHIC DRAUGHTSMAN,

Croydon and Purley District.

Salary £740 × £25 to £815 per annum, including London allowance, under N.J.C. Grade 2. Superannuable.

Applicants should have a good general education, experience in a distribution drawing office, and be fully conversant with mains recording and preparation of system diagrams, etc.

Applications, quoting ER, and naming two referees, on forms from District Manager, SEEBOARD, Electric House, Wellesley Road, Croydon, by 22nd March, 1961.

GEORGE WRAY,

Secretary. 7996

**TECHNICAL
ASSISTANT**

A YOUNG ELECTRICAL ENGINEER with H.N.C. is required for the testing of large high-voltage power transformers and auxiliary equipment. The work will be mainly concerned with impulse and high-voltage testing and special tests such as noise measurement. Experience in these particular fields is not essential, adequate training will be given.

Good commencing salary and conditions of service will be offered.

Apply :—

Personnel Manager

FULLER ELECTRIC LIMITED

Fulbourne Road, Walthamstow

London, E.17

7977

BRITISH TRANSPORT COMMISSION

requires in the Department of the Chief Electrical Engineer at the Electric Traction Research Testing Station, Rugby, Warwick

SENIOR TECHNICAL ASSISTANTS. Salary Range £925 - £1,125.

(Post 1). ENGINEER for experimental work on electric traction equipment. Candidates should have a degree and be qualified for A.M.I.E.E. or hold equivalent qualifications, with experience in research on electrical machinery.

(Post 2). ENGINEER or PHYSICIST to carry out experimental work on overhead equipment of electric railways. Candidates should have a degree or equivalent qualifications with experience in the application of modern instrumentation to research problems with special emphasis on electronic methods.

TECHNICAL ASSISTANTS, Group "B." Salary Range £925 - £1,000.

(Posts 3 & 4). ENGINEERS qualified for A.M.I.E.E. or A.M.I.Mech.E., and having experience of drawing office work or the conduct of experiments.

TECHNICAL ASSISTANT, Group "A."

Salary (age 17) £280, (18) £370, (19) £400, (20) £435 × £40 annual increments.

(Post 5). Candidates should have G.C.E. qualifications at "O" or "A" level according to age, including passes in science subjects or mathematics.

Superannuation scheme, certain travel facilities, medical examination.

Applications stating Post Ref., age, qualifications and experience to the Director of Establishment, British Transport Commission (Dept. ER), 222, Marylebone Road, London, N.W.1, within 14 days. 7976

**ELECTRICAL DRAUGHTSMAN AND
ESTIMATOR/DRAUGHTSMAN**

required by

J. LYONS & COMPANY LIMITED

(ICE CREAM DIVISION)

A vacancy exists for a SENIOR ELECTRICAL DRAUGHTSMAN required to have experience on General Distribution, Lighting, Motor Controls, Process and Sequence Controls associated with Automation. Some knowledge of Electronics would be an advantage.

A vacancy exists for a SENIOR ELECTRICAL ESTIMATOR/DRAUGHTSMAN required to have experience of Estimating for Electrical Contracting Installations, based on General Distribution Lighting, Motor Controls, Process and Sequence Controls. This will involve a certain amount of preparation of drawings to be used as a basis of estimates. H.N.C. desirable.

An attractive salary will be paid to the right men and the appointment offers good prospects for further advancement. The Company offers good conditions of service and a Contributory Pension Scheme. Holiday arrangements honoured.

Applications will be treated in the strictest confidence and should be made in writing to :—

The Personnel Manager

Lyons Maid House, Hammersmith Grove, London, W.6

7898

**CENTRAL ELECTRICITY
GENERATING BOARD**

London Division

APPLICATIONS are invited for the following superannuable post. Conditions of service in accordance with N.J.B. Agreement, Schedule A. Salary includes London allowance. Qualifications entitling to Graduate Membership of the I.E.E. or I.Mech.E. an advantage.

**STATION SHIFT CONTROL
ENGINEER, BLACKWALL POINT
POWER STATION**
(Vacancy No. 61/127).

Sound technical training necessary with experience in control and operation of modern generating plant and E.H.T. switchgear. Salary Class G, Grade 10 = £940 to £1,065 plus £90 to £101 10s. shift per annum.

Applications, quoting vacancy number, to (or on form from) Personnel Officer, Central Electricity Generating Board, London Division, P.O. Box 136, London, W.1, by 21st March, 1961. 7960

M E M

APPLICATIONS are invited for appointment to our sales staff as representative operating within the South Eastern Electricity Board area. The position offers excellent opportunities for the right man; it is pensionable and a motor car is provided.

Please apply in writing to :—

General Sales Manager

**MIDLAND ELECTRIC MANUFACTURING
CO. LTD.**

Reddings Lane, Tyseley, Birmingham, 11

7817

EAST MIDLANDS ELECTRICITY BOARD

Lincolnshire Sub-Area

**THIRD ASSISTANT DISTRICT
ENGINEER, LINCOLN DISTRICT**
(Vacancy No. 28/61).

Salary N.J.B. Class F, Grade 9, £890 to £1,015 per annum. There is a possibility that the Lincoln District will be reclassified to Class G from the 1st April, 1961.

The duties of the post will be to assist in the planning, construction, operation and maintenance of underground and overhead systems up to and including 11 kV.

The successful candidate will be required to reside in or near the City of Lincoln and to undertake standby duty.

Applications should be forwarded to the Manager, Lincoln District, Brayford Side North, Lincoln, within fourteen days of the date of this advertisement. 7993

NUCLEAR CHEMICAL PLANT LTD.

require a

Junior Electrical Draughtsman

Company established 2 years require man age 21-25 holding, or shortly to take, H.N.C.

Excellent prospects in an interesting and novel field. Good salary and working conditions.

Apply to :—

Chief Design Engineer

at 105-113, The Broadway

West Ealing

London, W.13

(Telephone, EALing 1893)

8002

Situations Vacant (continued)

WARWICKSHIRE COUNTY COUNCIL

Architect's Department

APPLICATIONS are invited for the following appointments:—

- (A) DEPUTY GROUP ENGINEER (HEATING),
Grade A (£1,450-£1,565).

Applicants should be members of the I.H.V.E. and have had several years' experience in design, costing and handling large contracts for heating, water supplies and allied services.

- (B) DEPUTY GROUP ENGINEER (ELECTRICAL),
Grade A (£1,450-£1,565).

Applicants should be members of the I.E.E. and have had several years' experience in design, costing and handling large contracts for lighting, power and allied services.

- (C) SENIOR ASSISTANT ENGINEER (HEATING),
A.P.T. IV-V (£1,140-£1,480).

Applicants should be Associate Members of the I.H.V.E. with some years' experience and competent to design and specify installations for major building schemes.

- (D) ASSISTANT ENGINEER (HEATING),
A.P.T. IV (£1,140-£1,310).

Applicants should be recently qualified engineers who are wishing to gain further experience in design of heating and allied services in association with a senior engineer.

- (E) ENGINEERING INSPECTORS,
A.P.T. III (£960-£1,140).

The successful applicants will be responsible for the inspection and maintenance of the heating, water supplies, electrical installations and allied services in buildings of a district of the county under the Assistant Maintenance Engineer. They should have had several years' experience either in a similar capacity or as foreman in charge of large contracts.

The commencing salary can be within the grades according to ability and experience. Five-day week worked. The Council have schemes for the payment of removal expenses and a lodging allowance to married officers.

Application forms and full conditions applicable to the appointments can be obtained from ERIC DAVIES, F.R.I.B.A., A.M.T.P.I., County Architect, Shire Hall, Warwick.

L. EDGAR STEPHENS,
Clerk of the Council.

Shire Hall, Warwick. 7903

NORRIS CONSULTANTS LIMITED

require for the

Electrical Engineering Department
at Bristol Head Office
the following staff:—

- 2 ELECTRICAL ENGINEERS
(Corporate Members).
2 ASSISTANT ELECTRICAL
ENGINEERS.
4 ELECTRICAL ENGINEERING
DRAUGHTSMEN.

Applications are invited from engineers and draughtsmen with experience in building installations, power station work, distribution and control equipment.

Send full details, quoting reference M.R.N., to Beacon House, Queen's Road, Clifton, Bristol, 8. 7853

EASTERN ELECTRICITY BOARD

Northmet Sub-Area

GENERAL ASSISTANT ENGINEERS
(Operation and Maintenance),
Sub-Area Engineer's Department
(Ref. 969) (43/61.N).

ENGINEERS are required for general duties, including the commissioning and testing of protective gear, automatic control and communication equipment. Candidates who lack specialist experience but who have a good technical background will be considered.

Salary N.J.B. Class N, Grade 14 (£1,090-£1,215) inclusive of London allowance.

Apply by letter to the Manager, Eastern Electricity Board, Northmet Sub-Area, Northmet House, Southgate, London, N.14, by 20th March, 1961. 7985

BRITISH RAILWAYS

EASTERN REGION ELECTRIFIED LINES

LONDON AREA

ASSISTANT CONTROL ROOM OPERATORS

required

under Railway Electrical Conditions to assist in the operation of the Electrical Control Room at Romford, Essex. Applicants should have served a recognised apprenticeship and possess knowledge of E.H.T. and L.T. Distribution Systems, Isolation Procedure and Safety Precautions. Shift working involved.

Rate of pay £12 2s. per week of 44 hours plus shift allowance 33s. Enhanced pay for overtime and Sunday duty. Applicants required to undergo medical examination. Certain free and reduced rate rail travel facilities. Pension and sick pay scheme. Prospects of promotion.

Apply in writing giving age, apprenticeship and experience to the Electric Traction Engineer (London Area), British Railways Eastern Region, off Ley Street, Ilford, Essex.

7980

NORTH EASTERN ELECTRICITY BOARD

APPLICATIONS are invited from suitably qualified engineers for the following appointments, which are subject to the conditions of the National Joint Board.

Wear Sub-Area

SENIOR ASSISTANT ENGINEER, Sub-Area Commercial Officer's Staff, Industrial Section, with location at Sub-Area Headquarters, Sunderland. Applicants should have a sound knowledge of the general uses of electric power and heat in industry and a wide experience of negotiations with all types of industrial consumers.

Salary Schedule A, Class L, Grade 4, £1,795/£1,950 per annum.

Tees Sub-Area

FOURTH ASSISTANT ENGINEER (Assistant Clerk of Works/Buildings), with location at Sub-Area Headquarters, Thornaby. Duties include supervision of the construction and maintenance of the Board's property, comprising substations, workshops, depots, service centres and offices. Applicants should be familiar with bills of quantities and be able to set out, measure up and deal with interim and final accounts.

Salary Schedule A, Class L, Grade 13, £965/£1,090 per annum.

York Sub-Area

FIRST ASSISTANT DISTRICT ENGINEER, York District. Applicants should have experience in the operation of H.V. and L.V. urban and rural overhead and underground distribution systems.

Salary Schedule A, Class G, Grade 4, £1,350/£1,500 per annum.

Applications stating age, qualifications and experience to be received by Assistant Secretary (Establishments), North Eastern Electricity Board, G.P.O. Box No. 117, Carliol House, Newcastle upon Tyne, 1, within ten days of the appearance of this advertisement. 7990

CENTRAL ELECTRICITY
GENERATING BOARD

South Western Division

THIRD ASSISTANT ENGINEER (Vacancy No. ER/AV/27/61) required in the Taunton District of the Divisional Electrical Department.

Superannuation scheme. Salary N.J.B. Class AX, Grade 8, Scale 10, £1,105-£1,325 per annum.

Applicants, who should be Corporate Members of the Institution of Electrical Engineers, must have experience of the commissioning of all types of electrical plant and equipment for operation in power stations and 132/275-kV transmission substations, together with a full appreciation of the maintenance services required by such equipment.

Previous applicants need not re-apply.

Applications on form A.E.6/ACT, obtainable from the Divisional Secretary, 26, Oakfield Road, Bristol, 8, should be completed and returned by 20th March, 1961. 7994

CENTRAL ELECTRICITY
GENERATING BOARD

South Wales Division

APPLICATIONS invited for the following superannuable N.J.B. Schedule A appointments in the South Wales Division.

ASSISTANT SHIFT CHARGE ENGINEER, USKMOUTH "A" POWER STATION, WEST NASH, NR. NEWPORT, MON. (Vacancy No. 43/ER/61).

Salary Class K, Grade 8, Scale 11, £1,275 to £1,410 per annum.

STATION SHIFT CONTROL ENGINEER, UPPER BOAT POWER STATION, NR. PONTYPRIDD, GLAM. (Vacancy No. 44/ER/61).

Salary Class H, Grade 10, Scale 7, £965-£1,090 per annum.

STATION SHIFT CONTROL ENGINEER, ABERTHAW POWER STATION, THE LEYS, NR. BARRY, GLAM. (Vacancy No. 45/ER/61).

Salary Class L, Grade 10, Scale 10, £1,190 to £1,325 per annum.

Applicants for the above posts should possess H.N.C. or equivalent qualifications and have had operating experience in a modern power station.

10% shift allowance payable in all cases.

Special application forms obtainable from Divisional Secretary, South Wales Division, Central Electricity Generating Board, Twyn-y-fedwen Road, Gabalfa, Cardiff, to be returned by 25th March, 1961. 7984

J. & P.

Staff required in
OVERSEAS DEPT.

- (1) TECHNICAL SALES. Man aged 30-40 years, qualified to H.N.C. standard Electrical Engineering, previous commercial experience preferred but not essential.
- (2) EXPORT DOCUMENTATION CLERK (male or female), aged 25-35 years, preferably with previous experience of bills of exchange, letters of credit, etc.
- (3) CABLE ESTIMATOR (male), aged 25-40 years, preferably with previous experience of handling overseas customers' enquiries and orders.

Applications stating age and experience to
The Employment Manager
JOHNSON & PHILLIPS LIMITED
Charlton, London, S.E.7

7949

MERSEYSIDE AND NORTH WALES ELECTRICITY BOARD

Headquarters

Second Assistant Engineer (Construction) required in the Chief Engineer's Department at Board Headquarters, Love Lane, Pall Mall, Liverpool, 3. Salary within range £1,375/£1,610 per annum (N.J.B. AX/5) with an initial placing according to qualifications and experience.

Duties will include the preparation of specifications for substation plant, design of indoor and outdoor substations operating at voltages up to and including 33 kV.

Applicants should have a sound general knowledge of substation plant and be technically qualified. Some experience of field construction would be advantageous.

Appointment subject to medical examination. Pension scheme.

Application forms, obtainable from the Assistant Establishments Officer at the above address, should be returned not later than 4th April, 1961. 7998

CENTRAL ELECTRICITY GENERATING BOARD

South Eastern Division

Electrical Engineer's Department, Northfleet District

THIRD ASSISTANT ENGINEER (Vacancy No. 82/61) required to be responsible for records, allocation of transport, operation of a job card system and detailed planning of stores and material to facilitate the work of construction, operation and maintenance of overhead lines and substations operating at 132 kV and 275 kV within the Northfleet District. Possession of H.N.C. (Electrical or Mechanical) or equivalent qualification and previous experience of work on the transmission system are desirable.

Salary within Class AX, Grade 8, £1,155 to £1,375 per annum including London allowance.

Applications giving age, details of qualifications, experience, etc., should be sent to the Personnel Officer, Central Electricity House, Lower Ham Road, Kingston-upon-Thames, Surrey, to arrive by 23rd March. 7986

EAST MIDLANDS ELECTRICITY BOARD

Nottingham Sub-Area

CABLE JOINTERS. Applicants should be fully trained on all forms of jointing, including plumbing, on medium-voltage and E.H.V. systems. Rate 5s. 4½d. and 5s. 6½d. per hour respectively.

ELECTRICAL FITTERS. Applicants should preferably have served an appropriate apprenticeship and be fully trained in fitting work. Experience on the erection and maintenance of H.V. and L.V. switch and fuse gear, and other substation equipment, would be an advantage. Rate 5s. 6½d. per hour.

Both the above vacancies are for a 42-hour 5-day week, under N.J.I.C. conditions of service.

Applications in writing stating age, experience and present employment to the Manager, Nottingham Sub-Area, East Midlands Electricity Board, Carrington Street, Nottingham, within 14 days of this advertisement. 7981

SOUTHERN ELECTRICITY BOARD

Field Engineer (Construction)

Sub-Area Engineering Department of No. 3 (Portsmouth) Sub-Area. Salary N.J.B. Class L, Grade 13 (£965-£1,090 per annum). N.J.B. conditions of service.

The duties of the post will be to carry out site supervision, installation and erection of plant, equipment and overhead lines, the laying of cables and other constructional work on all distribution systems up to and including 33 kV.

The successful candidate will be required to contribute to the Electricity Supply (Staff) Superannuation Scheme, if eligible.

Applications on forms obtainable from the Sub-Area Secretary, Lower Drayton Lane, Cosham, Portsmouth, and returned to him, quoting Z.1812, not later than 20th March, 1961. 7997

A CHIEF ENGINEER

required by
Konongo Gold Mines Limited
for work in Ghana

The successful applicant would be responsible for all mechanical and electrical work in power station, mine and reduction plant. Commencing salary, according to experience, in the region of £160 per month. The contract is continuous with three months' leave on full pay after each tour of fifteen months.

The company provides free accommodation, pays the passage outwards and homewards, and operates a provident fund.

Applications stating age and experience to:—

The Secretary
KONONGO GOLD MINES LTD.
49, Moorgate, London, E.C.2

7952

UNITED KINGDOM ATOMIC ENERGY AUTHORITY

ELECTRICAL ENGINEER

required at Dounreay Experimental Reactor Establishment, Thurso, Caithness, Scotland, to be responsible for the installation and maintenance of electrical plant associated with Reactors and Chemical Plant.

Applicants must have served a recognised engineering apprenticeship or pupillage and be at least Graduate I.E.E. or have equivalent qualifications.

Salary from £1,005 (a age 25) to £1,535 according to age and experience.

Rented housing and house purchase assistance available for married officers living beyond daily travelling distance. Hostel accommodation available. Contributory superannuation.

Send postcard for application form to Personnel Manager at above address, quoting reference 202/48.

7940

MERSEYSIDE AND NORTH WALES ELECTRICITY BOARD

ASSISTANT CONSUMERS' ENGINEER

(1) required in the Liverpool North District of the Board's No. 1 Sub-Area. Salary within range £965/£1,090 per annum (N.J.B. J/11).

Duties will include estimating and preparation of specifications for contracting work, and advising consumers on matters relating to electricity supply and the utilisation of electrical equipment. Possession of suitable technical qualifications will be advantageous.

Appointment subject to medical examination. Pension scheme.

Standard application forms should be forwarded to the Manager, No. 1 Sub-Area, 24, Hatton Garden, Liverpool, 3, not later than the 23rd March, 1961. 8000

UNILEVER MERSEYSIDE LIMITED

require Shift Control Engineers

at their Merseyside Power Station, Bromborough.

The SHIFT CONTROL ENGINEERS are responsible for the Company's steam and electrical distribution system, the import of power from Manweb, and the boiler plant loading at the Merseyside and Central Power Stations.

The successful candidates will preferably have gained Ordinary National Certificate in Electrical or Mechanical Engineering and have had suitable practical training in this sphere. Operational experience of power station plant will be an advantage.

Applications in writing should be sent to the Personnel Manager, Unilever Merseyside Limited, Lever House, Bebington, Cheshire. 7999

TECHNICAL SALES REPRESENTATIVES

Mawdsley's Limited
Dursley, Glos.

MAKERS of special purpose rotating electrical machinery with wide and varied applications require technically qualified (degree or H.N.C.) SALES REPRESENTATIVES in the North, Midland and South of England areas.

Experience in design or manufacture of the Company's type of product, and related sales experience are essential qualifications.

Salaries will be negotiated. A pension and life assurance scheme is in operation.

Applications will be treated in absolute confidence and should be addressed to the Managing Director giving a full summary of career and training. 7922

BUCKINGHAMSHIRE EDUCATION COMMITTEE

Slough College of Further Education
Principal: R. Edgar, M.Sc., M.A.

GRADE B ASSISTANT for Electrical Engineering required as soon as possible to teach light current subjects in National Certificate and City and Guilds Electrical Technicians' Courses. An interest in transistor techniques will be an advantage.

Salary in accordance with the Burnham Technical Scale, £700 to £1,150.

Details and forms of application from the Principal, William Street, Slough, to whom they should be returned within 14 days of the appearance of this advertisement. 7987

ACCOUNTS clerk, senior, required by large London electrical company. Excellent opportunity. Write experience, age, salary.—Box 7701.

ADMINISTRATIVE assistant required for contracts manager of large London electrical company. To control the preparation of accounts, trading reports, statistics, etc., and personnel. The position is superannuated after a probationary period and has good prospects for an individual capable of working under his own initiative. Previous similar experience in contracting an advantage. Reply to—Box 8003.

ASSISTANT storekeeper required for electrical contractors in London W.C. area. Wages commence approx. £12 10s. p.w. Own pension scheme. Good prospects. All applications will be acknowledged.—Box 7943.

CABLE contracts engineers required with experience installations to at least 33 kV. Must be prepared to travel anywhere in U.K. Apply giving details of work carried out to—Contracts Manager, Enfield-Standard Power Cables Ltd., Stockingswater Lane, Brimsdown, Middlesex (Tel. No. Howard 2711). 7885

CABLE estimator (male), aged 25-40 years, preferably with previous experience of handling overseas customers' enquiries and orders. Applications stating age and experience to the Employment Manager, Johnson & Phillips Ltd., Charlton, London, S.E.7. 7948

CABLE manufacturers require first-class representatives for the London and South-Eastern counties. Experienced men, with the desire and ability to take over senior positions, should submit fullest details in their first application to—Box 7942.

COST and accounts clerk required by West End (London) electrical contractors. Age 25-30. Write stating age, experience and salary required.—Box 5031.

ELECTRICAL design engineer for consultant's office, experienced all aspects general contracting. Age 25-35.—Laurence Oliver, 57, Victoria St., London, S.W.1 (SUL. 2041-3). 7896

ELECTRICAL design engineer required by consulting engineers for two-year tour in Arabian Peninsula. Experience in installation, distribution, transmission as applicable to all types of buildings. At least three years' recent drawing board experience. Family may accompany. Write — Brandt & O'Dell, 12, Queen Anne Street, London, W.1. 7946

ELECTRICAL site foremen, chargehands and electricians wanted for large contracts in London, Midlands and Wales. Conduit and M.I.C.C. installations. Write—Box 7931.

ELECTRICAL wholesalers invite applications from stores and clerical personnel with some knowledge of the trade, seeking a progressive position.—L.E.C., 92, Blackfriars Road, London, S.E.1. 7783

Situations Vacant (continued)

ENGINEER (estimating) required by West Riding electrical contractors. Experienced in industrial, commercial and general estimating. Able to control contracts from estimating to final stage. Apply stating experience, training and salary required.—Box 7970.

ENGINEER (estimating), senior, thoroughly experienced electrical cable installation work, required for progressive situation large London firm engineers. Write confidentially age, experience, salary.—Box 7848.

ESTIMATING/supervising and/or design and also junior engineer required for progressive positions for high-class installation work in an expanding company. Write in confidence stating age, experience and salary required to—Alliance Electrical, 2, Henrietta St., London, W.C.2. Progressive salary with possibility of a non-contributory pension and free life assurance. 118

EXPORT documentation clerk (male or female), aged 25-35 years, preferably with previous experience of bills of exchange, letters of credit, etc. Applications stating age and experience to the Employment Manager, Johnson & Phillips Ltd., Charlton, London, S.E.7. 7947

JOINTERS (E.H.T.) required. Previous experience essential. Present rate of pay 5s. 6d. per hour, N.I.C. conditions, including 42-hour 5-day week. Holiday and sick pay schemes. Optional superannuation scheme. Apply by letter to—District Manager, Midlands Electricity Board, 31 High St., Stourbridge. 7971

LABOUR and plant supervisor required for contracting section of large electrical company. Applicants should be thoroughly experienced in cable installation, jointing procedure and handling of labour, together with the purchasing and maintenance of suitable plant. An intimate knowledge of the rates of pay and conditions of working applicable to the appropriate trades essential. Permanent superannuated post. Write stating age and details of previous experience to—Box 7858.

MAJOR cable contractor operating in the N.E. area has vacancy for the superannuated post of supervising engineer. Applicants should hold O.N.C. or H.N.C. in Electrical Engineering. Similar experience with a major cable company or area board would be an added advantage. Apply stating age, experience and salary required to—Box 7968.

N. G. BAILEY & Co. Ltd., electrical contractors, require the services of two senior estimating engineers. The vacancies are at our Ilkley H.Q. and our Bristol branch office. Continued expansion at home and overseas enables us to offer permanent progressive positions of excellent promise to the right men. Salary is commensurate with ability. Good working conditions. Contributory pension scheme. Assistance given with removal expenses. Write giving details of age and experience to—Heathcote, Ilkley, Yorks. 7973

OVERHEAD line engineer required by consulting engineers in their head office. Experience required in design and contract work of tower and wood pole lines. Applications stating age, qualifications, experience and salary required to—Kennedy & Donkin, 12, Caxton St., London, S.W.1, quoting ref. JGW/H.S.J. 7884

POLYPHASE test. Experienced testers or improvers. These vacancies afford unique opportunity for experience on calibration of a wide range of integrating electricity meters and ancillary equipment. Staff status after qualifying period. Please enquire—Personnel Manager, Landis & Gyr Ltd., Victoria Road, North Acton, London, W.3 (ACOrn 2282). 7829

REPRESENTATIVE required by Burco Ltd., for London, having live connections with elec. wholesalers and elec. showrooms, North of Thames. Good salary and expenses, pensionable, car provided. Details in writing to—A. C. Burbidge, Burco Ltd., 212, Shaftesbury Avenue, London, W.C.2. 7945

REPRESENTATIVE required by established Essex and North London wholesalers. Experienced man with contacts in contracting, retail and industrial fields preferred but not essential. Salary, commission and car allowance, also superannuation scheme. Write details, etc., to—Box 7933.

REPRESENTATIVE required for plastic cable manufacturers: Berks, Bucks, Herts, Beds, Cambridge and parts East Anglia. Good salary. Commission. Car provided. High existing turnover available. Write full details experience, etc.—Director, J. Day & Co. (Derby Works) Ltd., Harrow Manorway, Abbey Wood, London, S.E.2. 7967

PROFESSIONAL firm in Iran requires a qualified electrical engineer for service in the Middle East. Associate membership of a recognised professional institution is essential, and candidates should have a minimum of 3-4 years' experience after qualification. Salary shall be not less than £200 per month tax free, and the appointment will be for a period of six months in the first instance, with the probability of extension of contract by mutual agreement. Free furnished bachelor accommodation and return air passages provided. Interviews will be held during the fortnight commencing 13th March, 1961. Replies stating age, qualifications, experience and when available to—Box 8006.

REQUIRED by electrical engineering company, Great West Road, young man aged between 18 and 24, with some previous experience of preparing quotations, general correspondence and sales routine, or alternatively undergoing technical training with a view to indoor sales career. Successful applicant must have drive and ultimately be able to work on own initiative. Canteen facilities, pension and bonus schemes in operation. Reply in confidence stating experience and expected salary to—Box 7859.

REQUIRED by London electrical contractor, a competent engineer to manage their Birmingham branch office. Experience must include telephone installations of all types. Please reply stating age, experience and salary required to—Box 7782.

ROUND OAK STEEL WORKS Limited require an electrical engineer as assistant to the chief electrical engineer. The appointment carries responsibility for technical development and improvement under the general guidance of the Chief Electrical Engineer. Candidates, preferably with experience in the heavy electrical field, should possess H.N.C. minimum, or graduate standard qualifications. Write giving age, details of experience, qualifications and salary level expected to the Manager, Personnel Dept., Round Oak Steel Works Ltd., Brierley Hill, Staffs. 7895

SALES representatives required for Midlands and Scottish areas. Knowledge of water heating desirable. Good salary, bonus and company car supplied. Pension scheme. Write giving full details to—Water Heater Manager, Berry's Electric Ltd., Touchbutton House, Newman Street, London, W.1. 7972

SENIOR and junior electrical design engineers/draftsmen required for consulting engineers' office, 5-day week, luncheon vouchers, Spring and Summer holidays. Applicants for senior positions must be experienced in design of electrical services for modern hospitals, universities, factories, etc. Please apply stating age, experience and salary required to—J. Stinton Jones & Partners, 21, Gloucester Place, London, W.1. 142

SENIOR technical draughtsman. Able to prepare working details for lighting fittings. Some experience in this field essential. Apply—Troughton & Young (Lighting) Ltd., 143, Knightsbridge, London, S.W.1. 7873

SURVEYOR required for wood pole line work. Permanency right man. Kirriemuir area.—B. French Ltd., Pike Mills, Kidderminster. 7897

TECHNICAL representative required, resident in Coventry, Birmingham or Wolverhampton district, for sale of switchgear, instruments, power factor correction capacitors, trunking and crane collector gear. Apply—A. J. Mare (B'ham) Ltd., Holly House, Shady Lane, Great Barr, Birmingham, 22a. 7934

TEST equipment designer. Large engineering company situated in South London engaged in the manufacture of meters have a vacancy for an electrical designer capable of running a test gear section (on retirement of existing departmental head). Will be expected to design and supervise manufacture of three-phase and single-phase test gear and electronic machine control equipment of all types. A good kWh metering knowledge is essential and an electrical degree preferred. Age limit 35/45. Write in confidence giving chronological history and salary required to—Personnel Office, Smith Meters Ltd., 170, Rowan Road, Streatham, London, S.W.16. 7975

TRANSFORMER designer. To lead and control design and drawing office. A person of wide experience coupled with ability and enthusiasm is required. The position carries commensurate salary and promising future. Apply in writing—Willesden Transformer Company Ltd., Manor Park Road, Harlesden, London, N.W.10. 309

APPOINTMENTS FILLED

Dissatisfaction having so often been expressed that unsuccessful applicants are left in ignorance of the fact that the position applied for has been filled, may we suggest that Advertisers notify us to that effect when they have arrived at a decision? We will then insert a notice free of charge under this heading.

SITUATIONS WANTED

A.M.I.E.E. (46), seeks executive/responsible/organising post in medium or small firm. Recent appointment, otherwise successful, lacks each feature wasting natural abilities. Trained and practised technical sales manager. Formerly designer; also site supervision. Wide experience light/medium engineering except for electronics. Successful with staff and customers whatever status. Prompt, clear correspondent. Hawk's eye for essentials, details or errors. Pride in work. London based but used to spur of moment travel.—Box 5036.

FULLY qualified electricians required for general maintenance and installation work on large integrated iron and steel works. Excellent conditions, pension scheme in operation. Apply to—The Employment Officer, Appleby-Frodingham Steel Co., Scunthorpe, Lincs. 7992

REPRESENTATIVE desires change, all types f.h.p. motors, geared, specials, etc.; also rotary equipment. Calling on all branches of industry in entire London postal districts and counties. Management considered.—Box 5032.

WHOLESALE'S E.W.F. branch manager seeks change with greater responsibility, prospects, perhaps working with smaller but growing concern, in responsible position with good prospects. London area.—Box 5027.

WORKING supervisor cable jointer and electrician, recently completed second overseas contract, 15 years' contracting experience, desires situation on overseas contracts, long or short tours. Particulars to—Box 5044.

ARTICLES FOR SALE

MOTORS

NEW CROMPTON PARKINSON, from $\frac{1}{4}$ h.p. to 80 h.p.; also 6,000 A.C. and D.C. reconditioned Motors and Starters.

IN STOCK HERE

B. E. WHITE
Brantwood Rd., Tottenham, London, N.17
Tel. EDMonton 4621-2 215

HOUSE SERVICE METERS

200—240-v. A.C. or D.C., 10 amps. capacity, quarterly type, from 25s. each, plus 2s. 6d. carr.

UNIVERSAL ELECTRICAL CO.

221, City Road, London, E.C.1 37

A.A. ELECTRICAL Co. for A.C.-D.C. motors, switchgear, exhaust fans, hoists, reduction gears, new or reconditioned units.—CHI. 5105. 67, Rothschild Rd. London W.4. 57

ABABCOCK & Wilcox water tube boiler will cut down your fuel costs; we can supply from stock. Two 40,000 lb. evap., 220 lb. w.p.; one 25,000 lb. evap., 200 lb. w.p.; 3,000 lb. evap., 400 lb. w.p.; Spencer Bonecourt boiler; also Marine, Cornish, vertical, etc.—Burford, Taylor & Co. Ltd., Boiler Specialists, Burtayco House, Church Street, Middlesbrough (Tel. Middlesbrough 2622). 122

A.C. and D.C. motors, generators, from stock.—Service Electric Co. Ltd., Honeyot Lane, Stanmore, Middx. (Edgware 5566/9). 91

A.C. and D.C. 1/- slotmeters. Guaranteed 2 years, 2½-50 amps. From 55/-. Repairs and recalibrations. See Billard: Tradex Meter Co., Surbiton (Tel. Elmbridge 2234/5/6). 169

A.C. and D.C. slotmeters and quarterlies. Reconditioned, guaranteed 2 years. Repairs and recalibrations.—Victor Electric Co., South View, Sweet Hill, Patcham, Brighton, Sussex. London agents, phone Downland 4682 (Surrey). 5001

ALTERNATORS, 3-phase, all sizes in stock from 7 kVA up to 330 kVA.—Britannia Manufacturing Co. Ltd., 22/26, Britannia Walk, London, N.1 (CLERkenwell 5512). 24

ALTERNATORS for sale from 1,100 kVA at 750 r.p.m. down to $\frac{1}{2}$ kVA. Single and three-phase. All voltages. More than 150 machines in stock. Automatic regulators and switchboards available.—Fyfe, Wilson & Co. Ltd., Station Works, Bishop's Stortford. 162

ALTERNATORS and generators, all types up to 150 kW.—Powerco Ltd., 312, York Road, London, S.W.18 (VAN. 5234). 151

ARGAINS in electric motors from A. Cooksley & Co. Ltd., 21/25, Tabernacle Street, London, E.C.2. Ring Monarch 3355. 50

BILLIARD Meters. 1/-, 6d. or 1d. slot. All time settings. From 170/-. See Quarterly.—Tradex, Surbiton. 170

CABLE, underground, all types ex stock.—E. M. Tatton & Co. Ltd., Kew Bridge, Brentford (ISLEworth 4534/5). 117

CABLE, underground, PILC/VIR/LC, ex London stock. Cutting orders same day delivery London area. Send for priced stock lists.—Batt Electrical Co., 6, Dock Street, London, E.1 (Tel. ROYal 5905). 316

CIRCUIT-breakers, various sizes in stock, A.C. and D.C., 200 amperes up to 2,000 amperes. Also dynamo and alternator switchboards.—Britannia Manufacturing Co. Ltd., 22/26, Britannia Walk, London, N.1. 26

CONVERTERS, motor-alternators, motor-generators, frequency changers, etc. All types up to 100 kW.—Powerco Ltd., 312, York Rd., London, S.W.18 (VAN. 5234). 150

CRANE motors. Direct current, series wound or compound wound, all voltages. We have large stocks.—Britannia Manufacturing Co. Ltd., 22/26, Britannia Walk, London, N.1. 22

DIESEL generating sets, all sizes to 500 kW. Britannia Mfg. Co. Ltd., Britannia Walk, London, N.1. 16

ELECTRIC motors and generating equipment.—E. M. Tatton & Co. Ltd., Kew Bridge, Brentford (ISLEworth 4534/5). 116

ELECTRIC motors, dynamos, alternators and motor generator sets of all sizes. We hold one of the largest stocks in England. New and reconditioned, with 12 months' guarantee.—Britannia Manufacturing Co. Ltd., Britannia Walk, London, N.1 (Clerkenwell 5512, 3 lines); also Works and Stores, Chobham, Surrey. 20

ELECTRIC motors, generators, motor generator sets, transformers, switchgear, etc., large comprehensive stock, overhauled and guaranteed. Copy of our Register, "Electrical Surplus," containing thousands of items of electrical plant, sent on request.—R. F. Winder Ltd., Belgrave Electrical Works, Leeds, 2. 54

FLUORESCENT tubes reconditioned and guaranteed with a life as new for 7s. 6d. each. Free collection and delivery in Lancs and Yorks. Save 40% on your tube replacement costs by using this service. We are also manufacturers of top quality fluorescent fittings, trunking systems, control gear and new fluorescent tubes. Generous discounts available.—Anglo-American Electrical Company, Olive Street, Bury (Telephone, Bolton 27251). 212

FOR sale, good unused and used machinery including electric motors, A.C. and D.C. dynamos, alternators, transformers, diesel and steam electric generating sets, mains failure sets, motor generator and Ward Leonard sets, switchgear, compressors, fans, capacitors, etc.—Fyfe, Wilson & Co. Ltd., Station Works, Bishop's Stortford, Herts (Tel. B.S. 1000/1). 161

GENERATING sets, portable or stationary, new and reconditioned, 1 to 100 kW, A.C. and D.C.—Powerco Ltd., 312, York Road, London, S.W.18 (VAN. 5234). 148

KARDEX, Roneodex and Shannovue cabinets, as new.—F. H. Jolly & Co. Ltd., 289, King St., London, W.6 (RIV. 5381). 202

MOTOR generator sets and converters, all sizes and voltages from $\frac{1}{2}$ kW up to 500 kW in stock.—Britannia Manufacturing Co. Ltd., 22-26, Britannia Walk, City Road, London, N.1 (Tel. Clerkenwell 5512, 5513 & 5514). 12

MOTORS and control gear, huge stocks all types, $\frac{1}{2}$ to 200 h.p.—Ramsbottom & Co. Ltd., Elec. Engineers, Keighley (5444/7). 70

NAMERPLATES, engraving, die-sinking, stencils.—Stilwell & Sons Ltd., 153, Far Gosford Street, Coventry. 108

PHASE converters, single to three-phase, several sizes in stock up to 90 h.p., 3-phase loading.—Britannia Mfg. Co. Ltd., Britannia Walk, London, N.1. 29

POLYPHASE kilowatt hour meters. Available from stock.—Universal Electrical, 221, City Road, London, E.C.1. 40

PLATING dynamos and motor generator sets, various sizes from 500 amps. up to 2,000 amps., with A.C. and D.C. motors.—Britannia Manufacturing Co. Ltd., 22/26, Britannia Walk, London, N.1. 15

PREPAYMENT 1s. slot house service meters.—Universal Electrical, 217-221, City Road, London, E.C.1. 30

PURLEY chokes and ballasts. Our 80-w. tapped h.p.f. ballast with starter switch-holder incorporated is proving itself the most popular unit. Suitable for most fittings, 57s. 6d. each subject.—F. W. Blanshard Ltd. (Dept. ER), Purley, Surrey (Uplands 4818/9). 52

QUARTERLY credit meters, single and polyphase, $2\frac{1}{2}$ -100 amps. From 20/-. Also D.C. See Television.—Tradex, Surbiton. 171

ROTARY converters in stock, all sizes; enquiries invited.—Universal Electrical, 221, City Road, London, E.C.1. 34

SMALL BR screws and nuts in steel, brass and stainless steel, from stock.—Premier Screw & Repetition Co. Ltd., Woodgate, Leicester. 180

TELEVISION slotmeters and time switches. Details from: Tradex Meter Co., Surbiton (Elmbridge 2234/5/6). 172

VENNER time switches, 200-240 v. A.C./D.C., 10-50 amps., from stock.—Universal Electrical Co., 221, City Rd., London, E.C.1. 38

WARD Leonard motor generating sets, all sizes.—Britannia Manufacturing Co. Ltd., 22-26, Britannia Walk, London, N.1 (Tel. Clerkenwell 5512). 10

400-cycle to 1,500-cycle motor alternators and alternators.—Britannia Mfg. Co. Ltd., Britannia Walk, London, N.1. 27

500-kW, 220-volt Met.-Vick. rotary converter, with transformer, 11,000 volts, 3-phase, 50 cycles, and accessories.—Britannia Mfg. Co. Ltd., Britannia Walk, London, N.1. 17

EQUIPMENT FOR HIRE

GENERATING set hire service. Consult the most experienced firm for A.C. and D.C. units from 2 kW to 240 kW, diesel or petrol, stationary or mobile, sale or hire, 24-hr. breakdown service.—Dawson-Keith Ltd., Hillview Rd., Sutton, Surrey (Fairlands 4401). 46

ARTICLES WANTED

WANTED

D.C./A.C. Motors, Transformers, Cables and all redundant Power Station plant wanted for dismantling.

ASK US TO QUOTE

B. M. T. CO. LTD.
London Road, Barking
(RIP. 3387/3715)

298

WANTED FOR CASH

SURPLUS Diesel Generating Sets, all sizes up to 1,000 kW. We dismantle and remove.

DAWSON-KEITH LTD.

Hillview Road, Sutton
(Fairlands 4401/2/3)

47

A.C./D.C. electric motors, generators, transformers, disused stocks of cable, power houses bought and dismantled.—Samuel Hyams, 129, Lambs Lane, Rainham, Essex (Rainham 4896). 125

SIX or more Tacho generators with or without control gear.—Fyfe, Wilson & Co. Ltd., Station Works, Bishop's Stortford, Herts. 8004

WANTED, D.C. and A.C. ball-bearing motors, motor generator sets, dynamos and alternators. Full details to—Britannia Manufacturing Co. Ltd., 22-26, Britannia Walk, London, N.1. 13

WANTED for prompt cash, ferrous and non-ferrous scrap, also plant for dismantling. Buyers of secondhand machinery and plant for re-use.—W. & H. Cooper Ltd., 176, Brady St., Bethnal Green, London E.1. 120

WANTED, rotary converters, any sizes.—Universal, 221 City Rd., London E.C.1. 35

WANTED, surplus stock cable, all types and sizes. We can inspect.—Box 220.

WORK WANTED AND OFFERED

A.C. and D.C. motor rewinds and repairs. Prompt service, fully guaranteed.—Edgware 5566/9; Service Electric Co. Ltd., Honey-pot Lane, Stanmore, Middx. 92

AVAILABLE capacity for winding fractional to 200-h.p. motors. Also machining and assembly of electrical components. Leading manufacturers please note. Skilled operatives, small overheads enable keen prices, by contract or otherwise. Rewinds and repairs.—S. W. Fletcher (Electric Motors) Ltd., 33, Elenora Street, Stoke-on-Trent (Tel. 44551). 48

CAPACITY available for electrical power equipment manufacturing. Distribution boards and cubicles. Power take-off units and power distribution problems of all types.—Norvall Bros. Ltd., Victorian Grove, London, N.16. 7966

CAPACITY available. Use our Toroidal Winding Machines. Capacity available for winding cores, having finished i/d of .055" up to 24" o/d with 6" maximum height. Experienced engineers, skilled operators are available to give efficient service and speedy delivery. Enquiries—Production Engineer, Toroid Division, Aveley Electric Limited, South Ockendon, Essex (SOO 3444). 7461

FLUORESCENT fittings, shells and chokes to BS 2818 (Licence No. 3237), coil winding, all sheet metal work.—D. E. Cowling & Sons Ltd., Romside Trading Estate, North St., Romford 47282. 60

INSPECTION and specification for elec. work; free-lance.—Beaumont, 334-6, King Street, London, W.6. 5045

METALWORK. All types cabinets, chassis, racks, etc., to your own specifications. Write—Dept. 'S', Philpott's Metal Works Ltd., Chapman Street, Loughborough. 211

PRODUCTION winding of armatures, stator, coils, transformers. Also special motors. Prompt and reliable deliveries.—Lewis Electric Motors Ltd., Moor Wks., Maidenhead, Berks. 194

BUSINESS OPPORTUNITIES

ELECTRICAL wholesalers, small/medium sized. Some radio. Excellent leased premises, North London.—Box 7719.

FOR sale, old-established electrical and mechanical engineering company in Swansea area. Small tax losses. Suitable for expansion. Proprietor proposes age retirement. Enquiries invited.—Box 7878.

RANGE of highly efficient patented limit switches, with large sales potential, offered to substantial manufacturer on royalty basis, or outright sale.—Box 5028.

AGENCIES

METWAY

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COMPANY MEETINGS

THE ENGLISH ELECTRIC GROUP

LORD NELSON OF STAFFORD ON MORE EFFECTIVE USE
OF BRITAIN'S TECHNICAL RESOURCES

THE Annual General Meeting of the English Electric Company Limited will be held on 23rd March in London. In the course of his statement circulated to stockholders, the Chairman, Lord Nelson of Stafford, said:

Output for 1960 was practically identical with that for 1959. Orders booked in 1960 were substantially higher than ever before and as a result there are good prospects for increased output in 1961. The Parent Company and certain of its subsidiaries showed substantially better results in 1960 than in the previous year.

However, after allowing for adverse factors there is a Group profit after tax applicable to members of the Company of £3,142,580 compared with £3,125,870 last year.

Investment for the Future

The immense developments in the electrical industry since the war have necessitated great research and development effort, larger workshops and machine tools, testing equipment of greater capacity and a considerable investment in education and training. You can therefore be confident that we have equipped ourselves to meet any future demands made upon us.

Rationalisation by merging of interests, research agreements and other methods is constantly under review to avoid wasteful duplication in the use of scientific and technical personnel and to ensure maximum loading of production facilities.

Unfortunately, the word rationalisation is sometimes misunderstood. It should not raise fears in the minds of those who work in industry because of changes which may take place in their employment, for the aim of such moves is to bring more work to this country and to ensure greater stability of employment.

Competition in Export Markets

Your Company has always played a leading part in export business, and something approaching a third of our great output goes abroad.

We must emphasise that 50 per cent of our costs are for raw materials and manufactured accessories, and we believe that those firms who supply us with them must also concentrate on cost reduction and share with us the responsibility of obtaining some of the overseas business now being lost to foreign competitors.

The Government's medium term export credit insurance period is often not long enough for capital goods and too expensive as compared with facilities offered by other countries. We, therefore, welcome the Government's assurance of encouragement to export business by improved credit facilities.

Manufacture Overseas

Political and economic changes occurring in all parts of the world are affecting British business in two principal ways. In the first place, many countries had been industrialised in the past by British finance and enterprise and many of their undertakings were staffed by British engineers, who naturally had a tendency to

accept automatically British standards and British equipment. In modern conditions these ties have been greatly loosened and what were previously regarded primarily as British markets are now scenes of intense international competition.

In the second place, many countries wish to move from an economy based mainly on primary industries to one including an increasing element of manufacture. I, personally, welcome these changes because I believe that they offer us even greater opportunities for export of capital goods in the future.

For this and other reasons your Company has played its part in developing overseas manufacture, having established factories in Canada, Australia, South Africa and India. These activities also enable us to maintain a selling organisation ready to meet these countries' needs and able to deal with special projects involving the importation of British equipment.

Power Generation

We continue to play a part in the British power programme and during 1960 our Atomic Power consortium with Babcock & Wilcox and Taylor Woodrow received the order for the Sizewell nuclear power station, the largest yet ordered anywhere in the world.

Among several important orders received is that for a 375 MW set, one of the first two units in the British power system employing steam at supercritical pressure. The C.E.G.B. have subsequently placed an order for even larger units of 500 MW each.

Traction

The traction activities of English Electric and our subsidiaries, Vulcan Foundry and Robert Stephenson & Hawthorns, as last year, have been mainly concerned with the re-equipment of British Railways. By the end of the year we had delivered more than 200 complete electric and diesel-electric locomotives of various types. We have now commenced delivery of the Deltic diesel-electric locomotives, the most powerful to be built anywhere in the world.

Last year I gave a warning regarding the proposed revision of the Programme for British Railways, which threatens to slow up the orders necessary to keep our shops in stable employment. As time goes on we shall have to rely more and more on our export sales to do this.

Computers

The Company's Deuce electronic computer is well known. An important development is the construction of a second generation of fast high capacity computers for general applications.

Domestic Appliances

The big expansion in your Company's domestic appliance operations was temporarily checked by the restrictions imposed on hire-purchase transactions. The need for control upon credit is admitted, but the fluctuations in

restrictions make it difficult for manufacturers to plan for the production and sales of these products.

Aviation

I am pleased to say that the new grouping of aircraft companies forming British Aircraft Corporation, in which your Company has a 40% interest, has engendered the warmest collaboration at all levels and we look forward to the future with confidence.

Aircraft Electrical Equipment

The Aircraft Equipment Division of your Company at Bradford has now fully established its position in the aircraft electrical equipment industry.

Other Activities

Successes were recorded in the many other activities of the company.

Marconi's Wireless Telegraph Company

The company has maintained the level of turnover but trading profit is unfortunately down. However, there is an increase in the intake of orders. Our principal subsidiary, Marconi Instruments Limited, has had another very successful year.

Marconi's have again made a notable contribution to Britain's export trade, half our total output going overseas. You will be particularly interested to know that we are engaged in the exciting field of communications by satellites.

Marconi-equipped television and broadcasting stations were completed in the United Kingdom, Australia, Brazil and Nigeria and were ordered by New Zealand, Canada, Venezuela, Mexico, the British Broadcasting Corporation and the Independent Television Authority.

The year under review has been one of steady progress in almost every direction and we can face the future with confidence.

Marconi International Marine Communication Company Limited

There has been some improvement in shipping generally during the year. While the greater proportion of our output has been for radio equipment for new British tonnage, we have considerable business in hand for equipping foreign flag vessels and a higher proportion of our production than ever before is going to fulfil these orders. They come from all parts of the world and are for all types of Marconi marine equipment.

English Electric Valve Company

The company has again improved output and turnover and maintained trading results at a very satisfactory level.

D. Napier & Son Limited

There has been no improvement in the results for 1960. Important organisational changes have been made with a view to more efficient operation and a fuller exploitation of existing products. Further Government contracts are expected for the Gazelle helicopter engine. 8000

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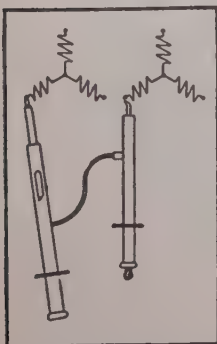


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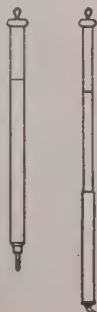
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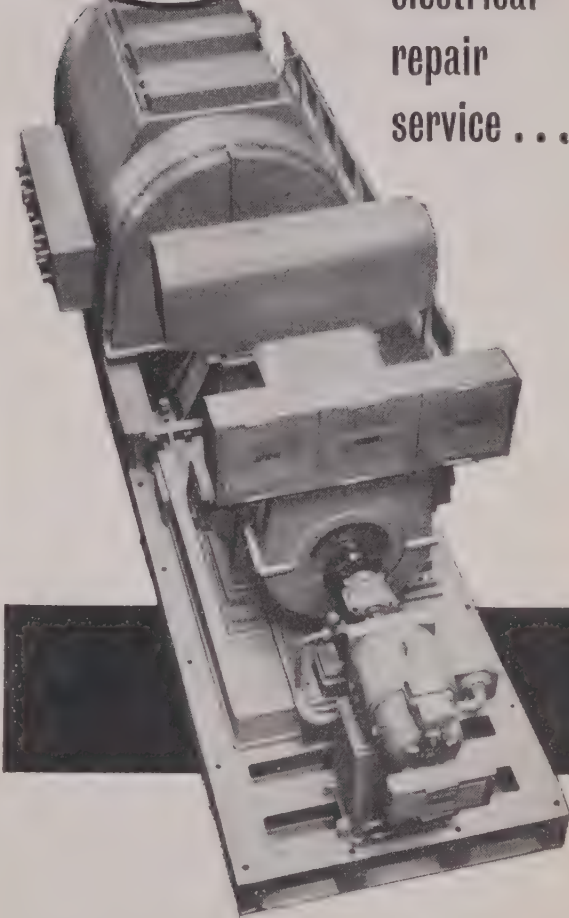
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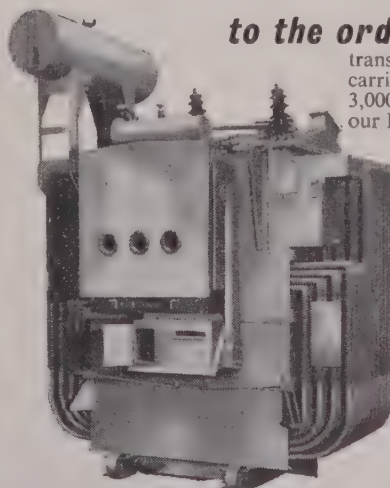


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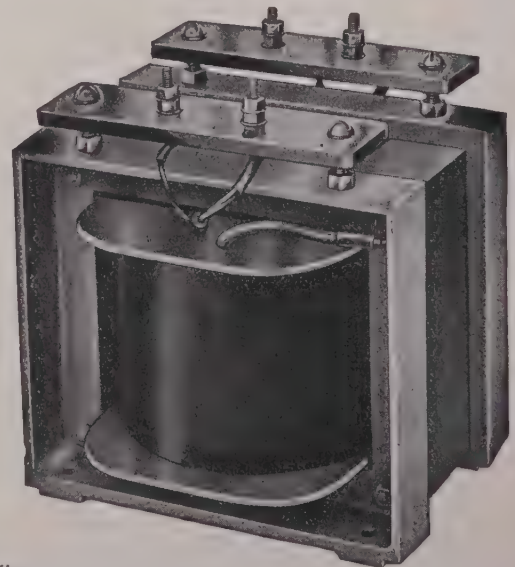
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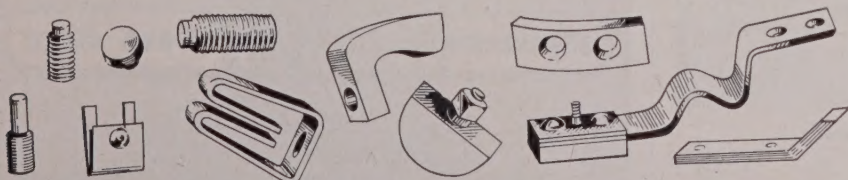
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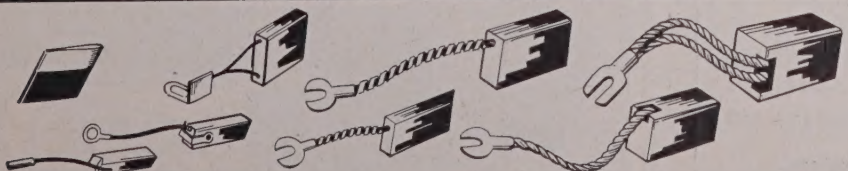
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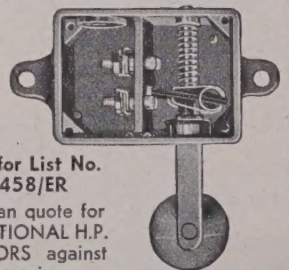
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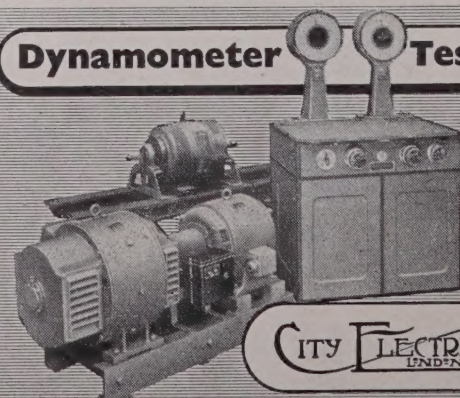


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